User Guide

Version 1.2.0 rev2

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1. SAFETY

R/C models such as helicopters are not toys! It is necessary to check all the manufacturer instructions of the model, comply with local laws and to perform pre-flight inspections of the model to address all possible mechanical concerns, electrical concerns and failures immediately.

Rotor blades and propellers rotate at high speed and can lead to serious injury to persons and property if not respected.

If you encounter any problems, contact your dealer or other experienced modelers.

Pay particular attention to your own safety and the safety of others. Never fly amongst or over people, animals, or on private property without prior authorization from the property owner.

Fly only in safe places where no additional damage is possible to other objects, because the model can suddenly become unmanageable for various reasons, such as failure of electronics, mechanical failure, pilot error or radio interference.

Do not try to fly damaged models or perform repairs using damaged parts; always replace damaged parts with new ones.

Never fly a model which exhibits excess vibrations, this may cause unwanted flight characteristics or in-flight failures. Find the source of the vibrations and fix the problem.

Spirit is not an autopilot, it is necessary to have knowledge of flying R/C models. The system is only designed to improve flight performance.

We recommend using R/C simulators designed for training before the first flight.

The user takes full responsibility for any damage or injury caused while flying an R/C model equipped with one of our devices. The manufacturer can neither guarantee nor control the conditions in which the unit is being used.

2. INTRODUCTION

Spirit is a device for stabilizing R/C models such as flybarless helicopters. Spirit features include electronic paddle simulation, vibration logging, support for various Tx/Rx types and a rudder gyro for those who want to continue using a mechanical flybar.

Thanks to flybarless mechanics, the system improves the efficiency and maneuverability of the helicopter and it's stability while also extending flight times.

Flight characteristics are easily customizable according to your preferences, from stable flight for beginners to demanding acrobatics with maximum agility for experts.

Because the Spirit uses the most advanced technology, the model can be controlled very precisely even under harsh conditions such as strong winds while maintaining a constant pirouette.

This user guide will help you to properly mount the unit on a model and to carry out the step by step configuration to prepare your model for its first flight. It is very important to carefully adjust everything properly to make your first flight as pleasant and trouble free as possible.

Please check our website; spirit-system.com for downloading the latest firmware and software updates.

You can also raise any questions in our forum.

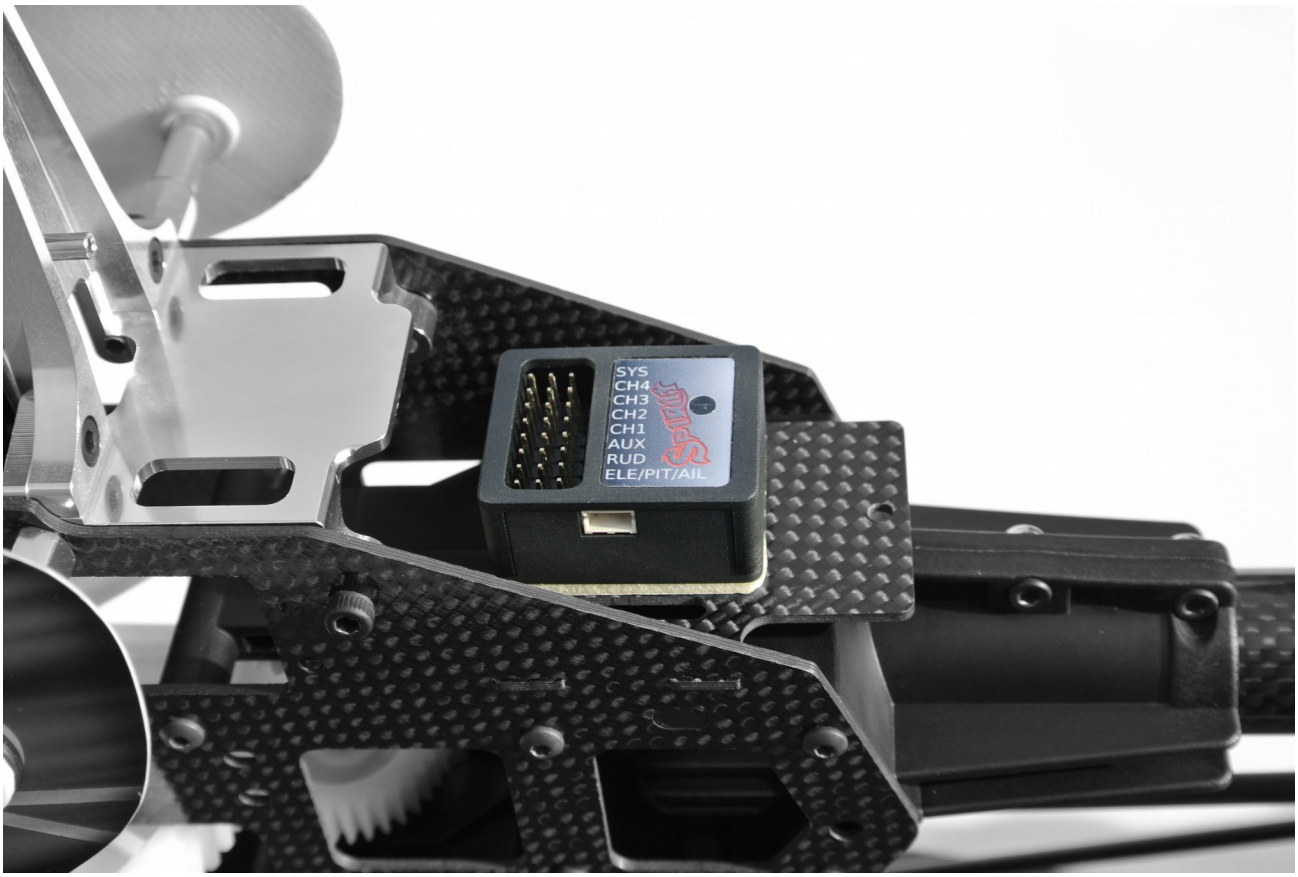
3. INSTALLATION

Properly mounting of Spirit plays an important role for the correct operation of your model.

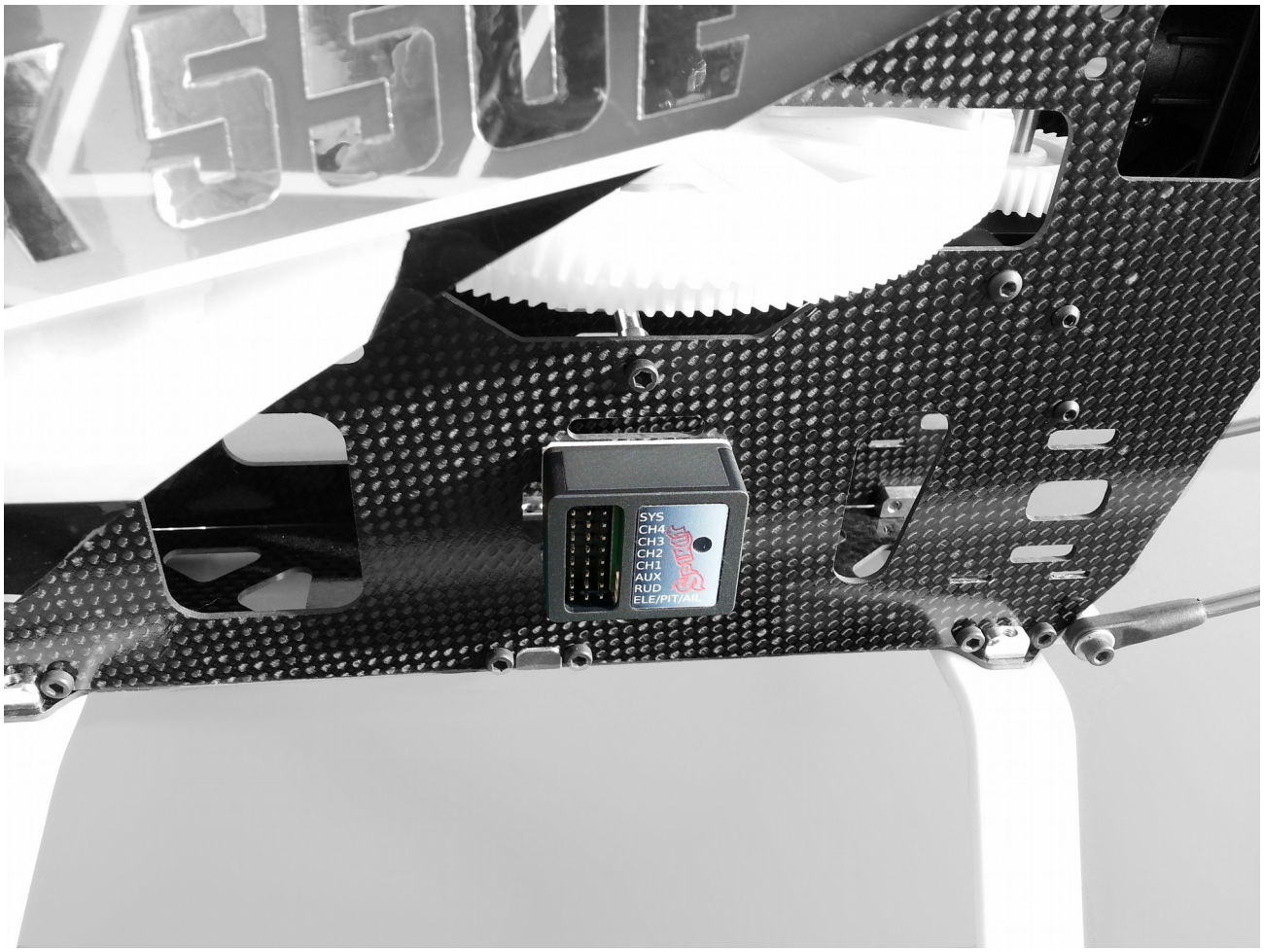
Find a suitable location where vibrations are as low as possible - this is usually the same location shown by the manufacturer for mounting a gyro.

It is VERY important that the unit should be mounted so that the unit is exactly perpendicular to each rotational axis.
Depending on your preference and available space it can be mounted in two different positions:

Horizontally
The unit can be mounted horizontally so the connectors face upwards. It can be rotated by 180° on the yaw axis so that the connectors are situated to either the front or the rear of the model.



Vertically
The unit can be mounted vertically so that the connectors face outward.
It can also be rotated by 180° on the elevator axis so that the connectors can be situated toward either the front or the rear of the model.
The unit must always be positioned parallel to the longitudinal axis of the model.



In order to better insulate against any vibrations from the model, it is necessary to choose the right double-sided mounting tape. The tape should limit any transmission of vibrations from the model to the Spirit which may produce undesirable flight characteristics.
Vibrations may also be caused by incorrectly balanced blades, damaged bearings, bent shafts and other mechanical issues.

4. WIRING

Wiring to the unit depends on the type of receiver used.
Spirit can be used as a standalone tail gyro or as a flybarless system.

NOTE
Spirit is pre-programmed to 1520µs servo neutral impulse and 50Hz frequency – please ensure you have the correct servo parameters selected as specified by your servo manufacturer.

If the neutral impulse of your servo/s is different to the above, such as 760µs, do not connect this servo yet as it could be damaged.

Some connectors have non-standard dimensions that could interfere with neighboring connectors after plugging in the unit. As a solution, we recommend replacing these connectors with JR or Futaba type.

Never plug a connector for powering the unit into the SYS or ELE/PIT/AIL positions or you may risk damaging the unit.

4.1. STANDALONE GYRO AND FLYBAR

Owners of flybarred helicopters can take advantage of the heading hold gyro, which keeps the tail in the direction given by the transmitter regardless of effects from wind or any outside forces.

Connect the rudder servo to the *CH4* port of the Spirit unit.
If you also use a standard receiver, you will need to connect GEAR (or AUX) from your receiver to the AUX port on the Spirit unit.
Also, you will need to connect your receiver RUD port to the RUD port on the Spirit unit.

Even if you do have a flybarred model, you can also connect the unit in the same way as a you would a flybarless one. This allows you to use the full potential of the unit including Stabilization and Rescue mode. In order for this to work correctly, it is necessary to tick the "Flybar mechanic" parameter in the Stabi tab during setup. All other parameters can be configured just the same as with a flybarless head.

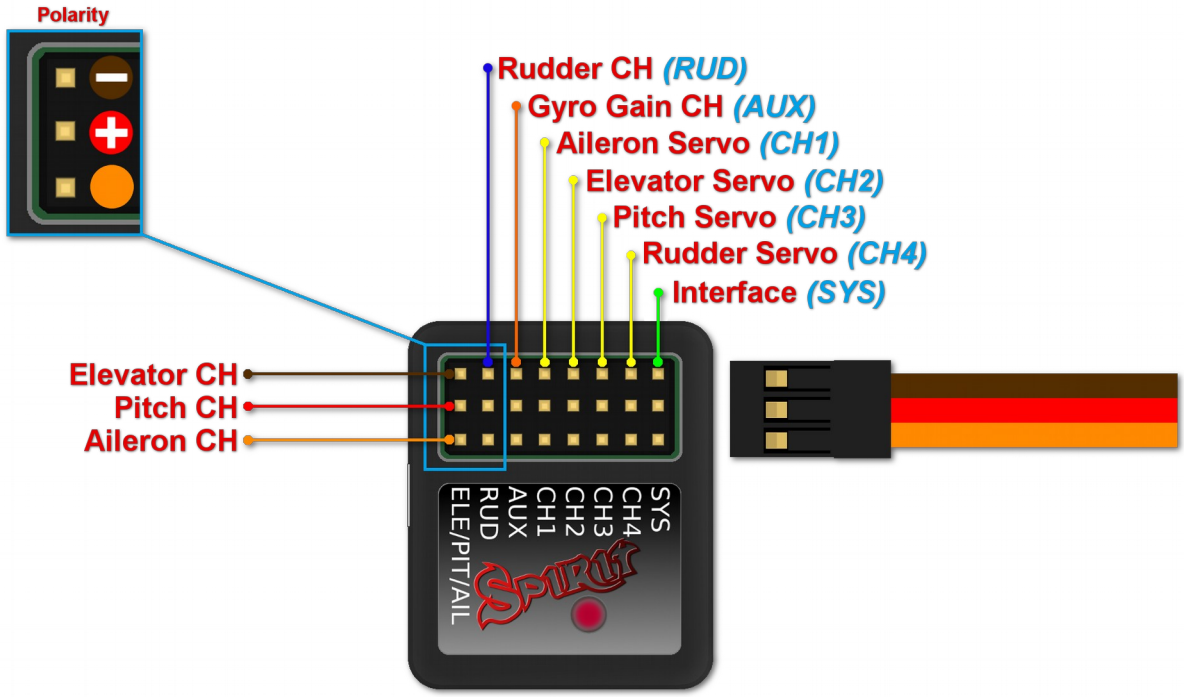
4.2. FLYBARLESS

Flybarless helicopters can take advantage of the full capabilities of the Spirit unit. The Spirit will stabilize the model on all axes and also make it less affected by wind, extend flight times and increase the agility of your model.
When properly set up, flight characteristics should be more stable which will give you the confidence to carry out even the most challenging maneuvers.

Unlike flybarred helicopters, the cyclic servos on a FBL helicopter are more directly connected to the rotor head and blades, so the demands on the servos are significantly higher. This means that your cyclic servos should be stronger to cope with this and also faster to respond as quickly as possible to any commands the Spirit unit sends them.
Flybarless rotor blades are also different from blades designed for flybarred models. For optimum flight characteristics it is recommended to use them.
When using the Spirit unit as a flybarless system, all servos should be connected in the corresponding positions:

CH1 - aileron
CH2 - elevator
CH3 - aileron / pitch
CH4 - rudder

4.3. CONNECTION OF STANDARD RECEIVER (PWM)



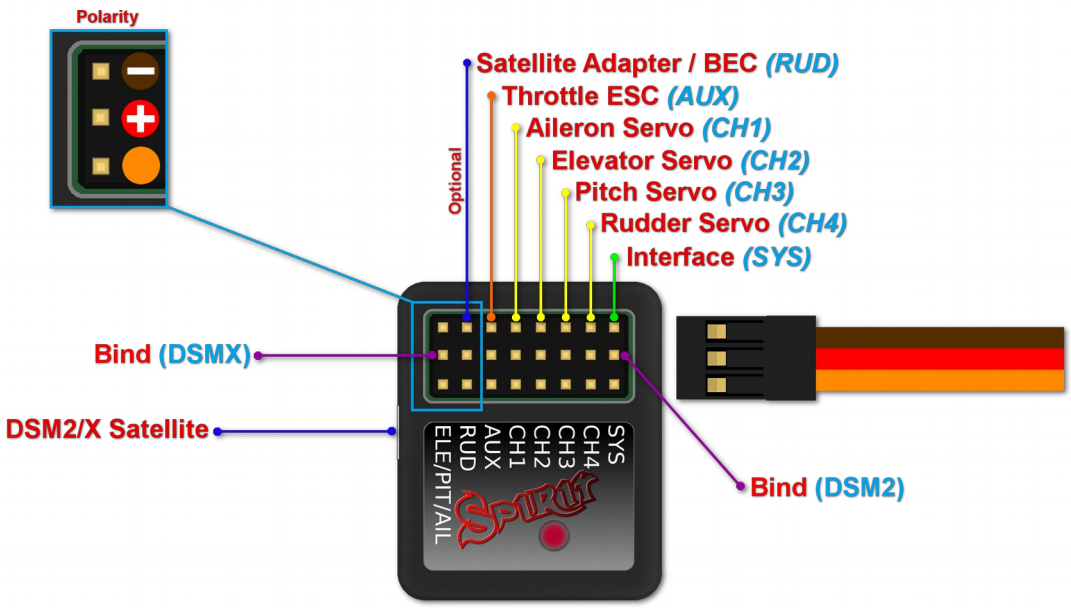
For standard receivers it is necessary to use two normal and one special cable. Three connectors from the special cable should be plugged into the receiver and the end of this cable to the unit.

The unit is powered by two cables from the receiver connected to AUX and RUD positions. The Throttle cable should be connected to the receiver as well.

The easiest way you can start connect RUD with Rudder output in the receiver. Then continue with AUX which should be connected to the Gyro Gain channel output. Next, connect the Aileron, Elevator and Pitch (Aileron 2) channels. If you are not sure whether you have the correct output or not, you can plug in one servo and power the unit to verify that your connection is correct. This can be repeated for each servo. The diagnostics tab is very helpful too.

Never plug a connector for powering the unit to SYS or ELE/PIT/AIL ports.

4.4. CONNECTION OF SPEKTRUM DSM2/X SATELLITE



Connection to a BEC is optional. If the model is powered by an external BEC, this must be connected to the RUD port. Also the power lead from the ESCs internal BEC must be disconnected.

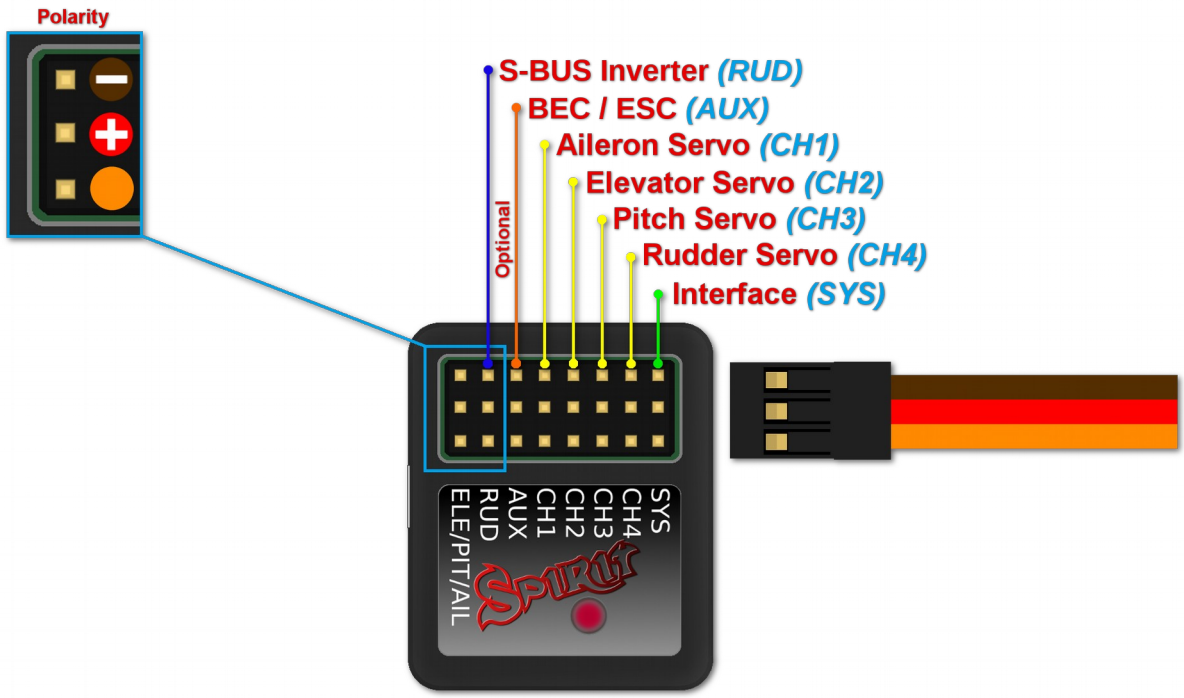
A second satellite can be connected, but this can only be achieved via a special adapter connected to the RUD port. This adapter can be purchased separately. Before satellites can be used they must be bound to your transmitter, taking into account any failsafes that need to be set.

To use both, two satellites and an external BEC, be sure to use a Y-harness made from large gauge wire to supply the high current that is needed.

To bind the satellites, insert a bind plug in the SYS port for DSM2 satellites or the ELE/PIT/AIL port for DSMX satellites. Power cycling the Spirit start the bind process. Once successfully bound, the STATUS LED will go out and the satellite LED will come on.
If the second satellite fails to bind, swap the satellites and repeat the bind process.

Be sure Receiver type in the software is configured to Spektrum DSM2/X or else binding process will not work.
Never plug a connector for powering the unit to SYS or ELE/PIT/AIL positions.

4.5. CONNECTION OF FUTABA S-BUS RECEIVER



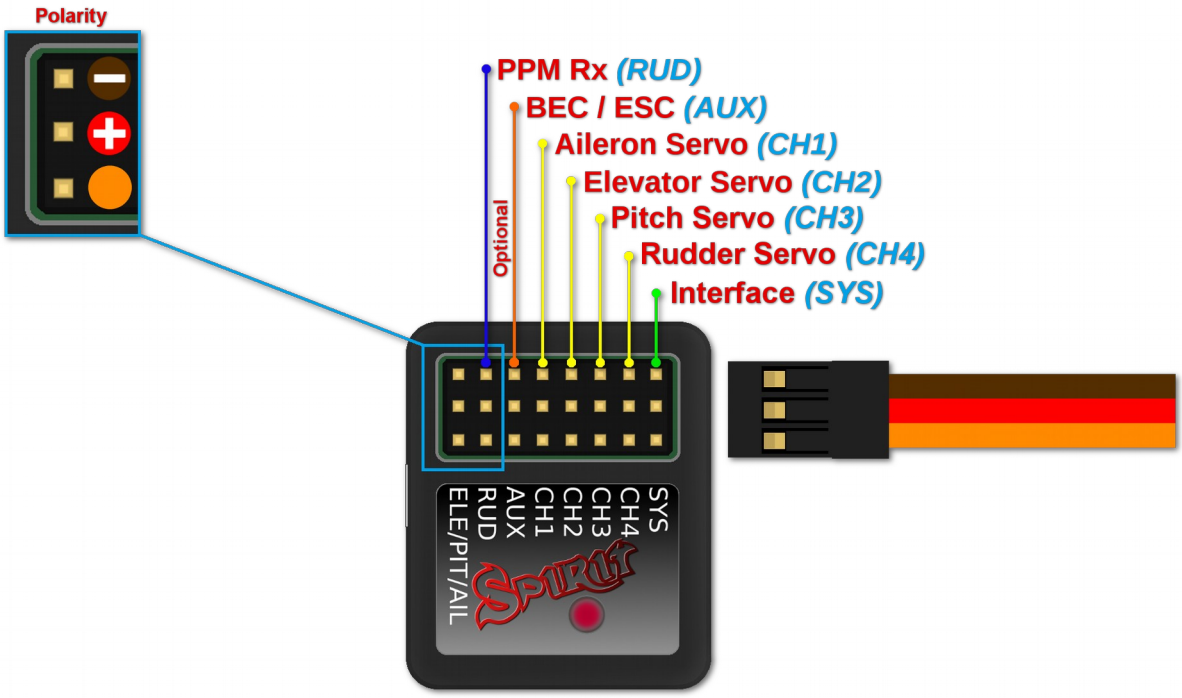
NOTE
When using S-BUS it is necessary to use an inverter that replaces the cable between the receiver and the Spirit unit's RUD port. This inverter cable can be purchased separately.

Connection to a BEC is optional. For models of 500 size and larger it is recommended to use dual power supply cables due to the increased power consumption. That means besides the inverter, an additional power supply cable should be connected to the AUX port.

When using this type of receiver you can connect the throttle cable directly to the receiver. Alternatively, you can assign the throttle channel in the software and use the AUX as throttle output from the unit.

Never plug a connector for powering the unit to SYS or ELE/PIT/AIL ports.

4.6. CONNECTION OF PPM RECEIVER

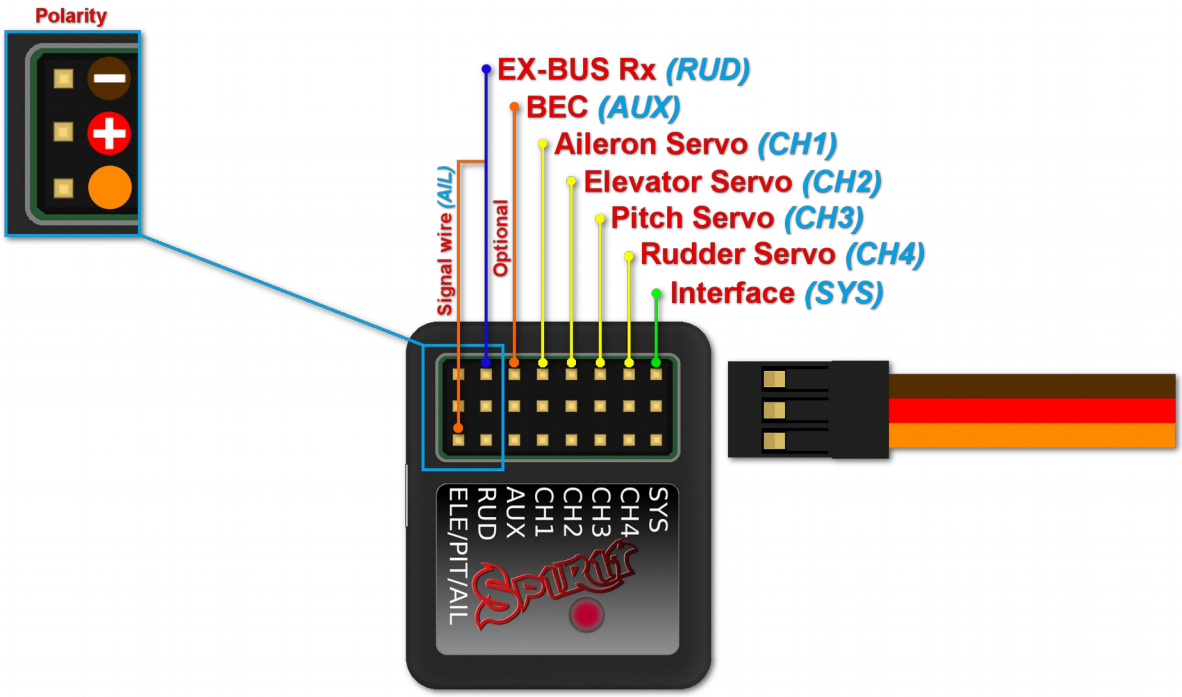


NOTE
Connection to a BEC is optional. For models of 500 size and larger it is recommended to use dual power supply cables due to the increased power consumption. That means besides the communication cable, an additional power supply cable should be connected to the AUX port.

When using this type of receiver you can connect the throttle cable directly to the receiver. Alternatively, you can assign the throttle channel in the software and use the AUX as throttle output from the unit.

Never plug a connector for powering the unit to SYS or ELE/PIT/AIL ports.

4.7. CONNECTION OF JETI EX BUS RECEIVER



NOTE
Connection to a BEC is optional. For models of 500 size and larger it is recommended to use dual power supply cables due to the increased power consumption. That means besides the inverter, an additional power supply cable should be connected to the AUX port.

When using this type of receiver you can connect the throttle cable directly to the receiver. Alternatively, you can assign the throttle channel in the software and use the AUX as throttle output from the unit.

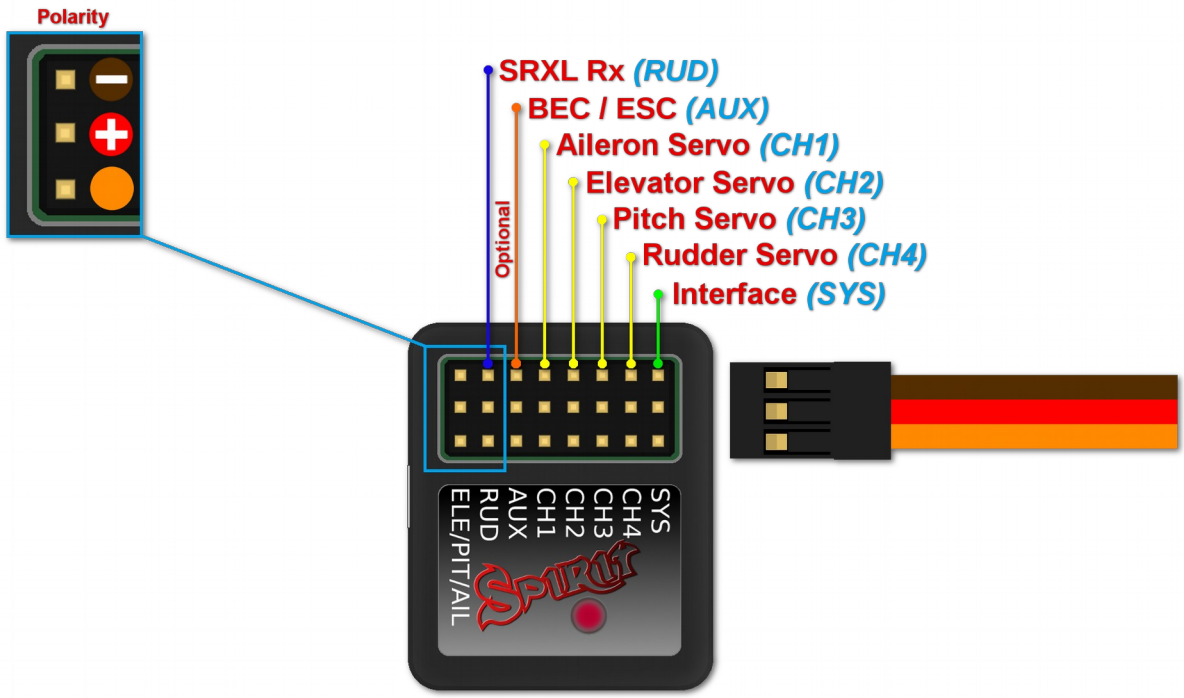
This connection type now supports the new integration with JETI Model transmitters. You can now fully configure the Spirit unit remotely through the JETI Model transmitter.

Remember to configure the receiver type through the software or the integration will not work.

A special cable is needed to enable this communication.

Never plug a connector for powering the unit to SYS or ELE/PIT/AIL ports.

4.8. CONNECTION OF SRXL/SUMD RECEIVER



NOTE
Connection to a BEC is optional. For models of 500 size and larger it is recommended to use dual power supply cables due to the increased power consumption. That means besides the communication cable, an additional power supply cable should be connected to the AUX port.

When using this type of receiver you can connect the throttle cable directly to the receiver. Alternatively, you can assign the throttle channel in the software and use the AUX as throttle output from the unit.

Never plug a connector for powering the unit to SYS or ELE/PIT/AIL ports.

4.9. CONNECTOR ORIENTATION

All cables connected to the unit must be oriented so that the signal wire (Lightest color wire) is closer to the connector pin label, towards the center of the unit. This orients the negative (darkest color wire) toward the edge of the unit.

5. CONFIGURATION

Configuration is the next and one of the most important steps for correct operation of the system.
Configuration is performed using the software, which combines efficiency and simplicity while offering adjustable parameters, including advanced parameters.

5.1. CONNECTION TO PC

Before you begin the actual configuration it is necessary to connect the system to a computer via a USB port. Depending on the operating system and computer, a driver may need to be installed after connecting the cable to the USB port.

Once connected and the driver is installed successfully a new virtual COM port should be visible in the software and device manager.

MS WINDOWS
Install the driver via the software installer. This process will be described in a following section.

APPLE MAC OS X
Download and install the driver from the following URL:
http://spirit-system.com/dl/driver/SiLabsUSBDriverDisk.dmg

GNU/LINUX
Nothing needs to be installed.

5.2. CONNECTION WITH THE UNIT

NOTE
If the unit is not configured yet (e.g. a new unit) it is advised to not connect any servos yet.

If you have already attached the USB interface to your computer, next connect the interface cable to the SYS port of the Spirit FBL unit.
The Spirit FBL unit can not be powered from the USB cable/SYS port so it is necessary to power it from either the receiver, a BEC or an external battery pack.
The RUD and AUX ports are used to power the Spirit FBL unit and if using a BEC or battery pack it is suggested to connect to these ports with a voltage between 3V and 15V.
The middle wire must be the positive voltage connection.

Never plug a connector for powering the unit to SYS or ELE/PIT/AIL ports.

5.3. CONFIGURATION SOFTWARE INSTALLATION

The configuration software is available for MS Windows, Apple Mac OS X, GNU/Linux and Android platforms and is available from the spirit website: spirit-system.com

Below are the installation instructions for the supported platforms.

MS WINDOWS
Run the installer and follow the wizard.
If the driver is not installed yet, you will be given the option to do so during the installation process.
The installer will go through all the necessary steps to prepare your computer for running the configuration software. Upon completion of the installation process, the configuration software can be launched from your desktop or program list, called "Spirit Settings".

APPLE MAC OS X
Install the downloaded software by opening the DMG file and then moving the content to your Applications folder. Configuration software can be launched from the Applications folder with "Spirit settings".

GNU/LINUX
Extract all the files from the downloaded archive to, for example, your home directory.
Configuration software can be launched from the newly created directory with the file "settings.sh".

5.4. CONFIGURATION SOFTWARE

Once the software is installed, ensure your Spirit unit is connected via USB to the SYS port, powered on and initialized (LED lights are on), then run the software on your computer.

NOTE
The configuration software should be started after the unit has initialized. Whenever the Spirit FBL is initialized (status LED is on) and connected, you can make adjustments to the settings.
Configuration during flight is not possible due to the associated safety risks.

PROBLEMS WITH WINDOWS
If the configuration software is unable to detect a valid COM port, you can try starting the software as Administrator.
Alternatively, check the COM port number. If the value is too high try reconfiguring the port number (Silabs device) to, for example, COM1 – COM4. For notebooks it is also worth disabling any USB power saving features in Device manager.

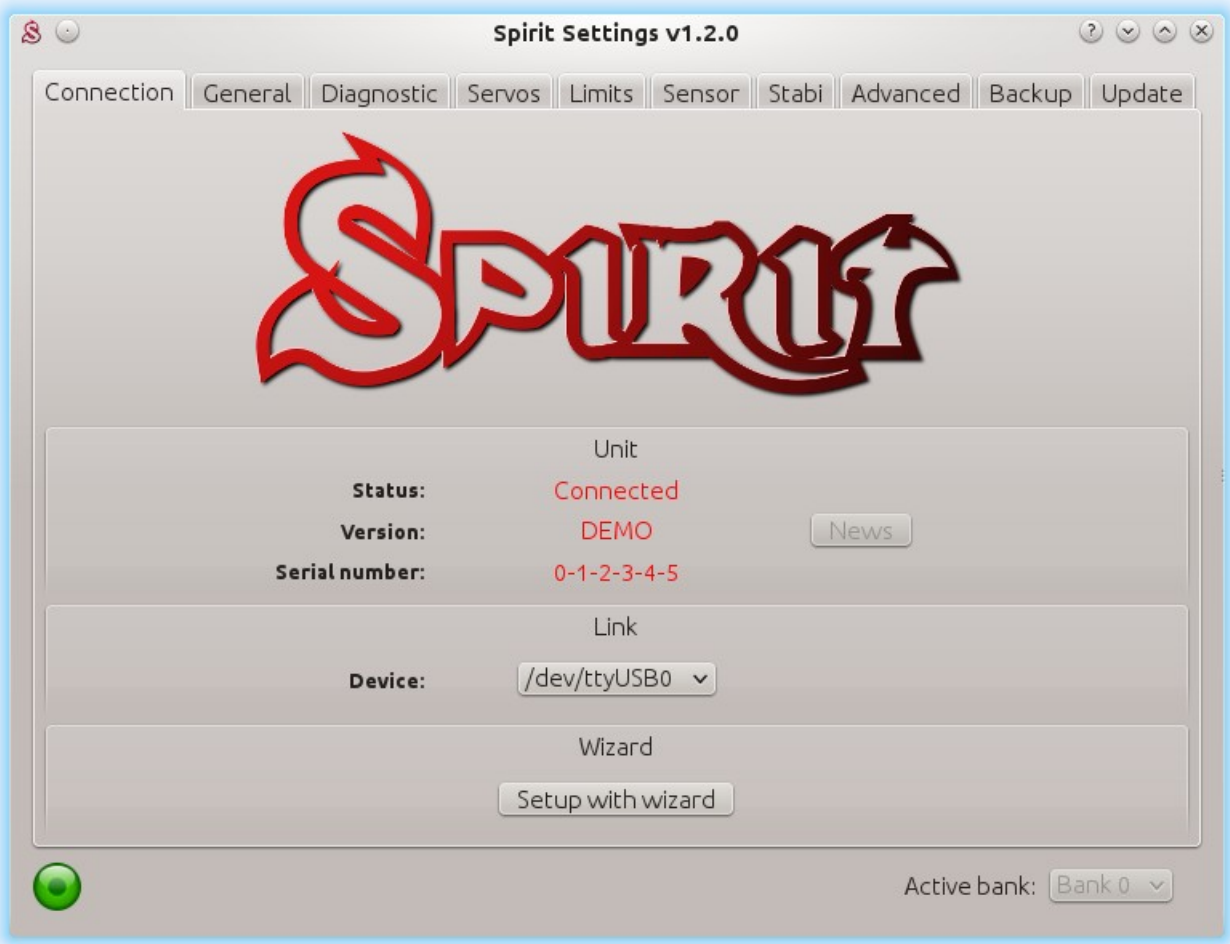
5.5. SOFTWARE USAGE

After successful connection of the Spirit FBL unit, all configuration features should be accessible. If not, try to either choose another COM port (Device) or try to restart the software, disconnecting the unit from the power supply and repeating the procedure.

Make sure the software is launched <u>after</u> the unit has initialized.

5.5.1. CONNECTION TAB

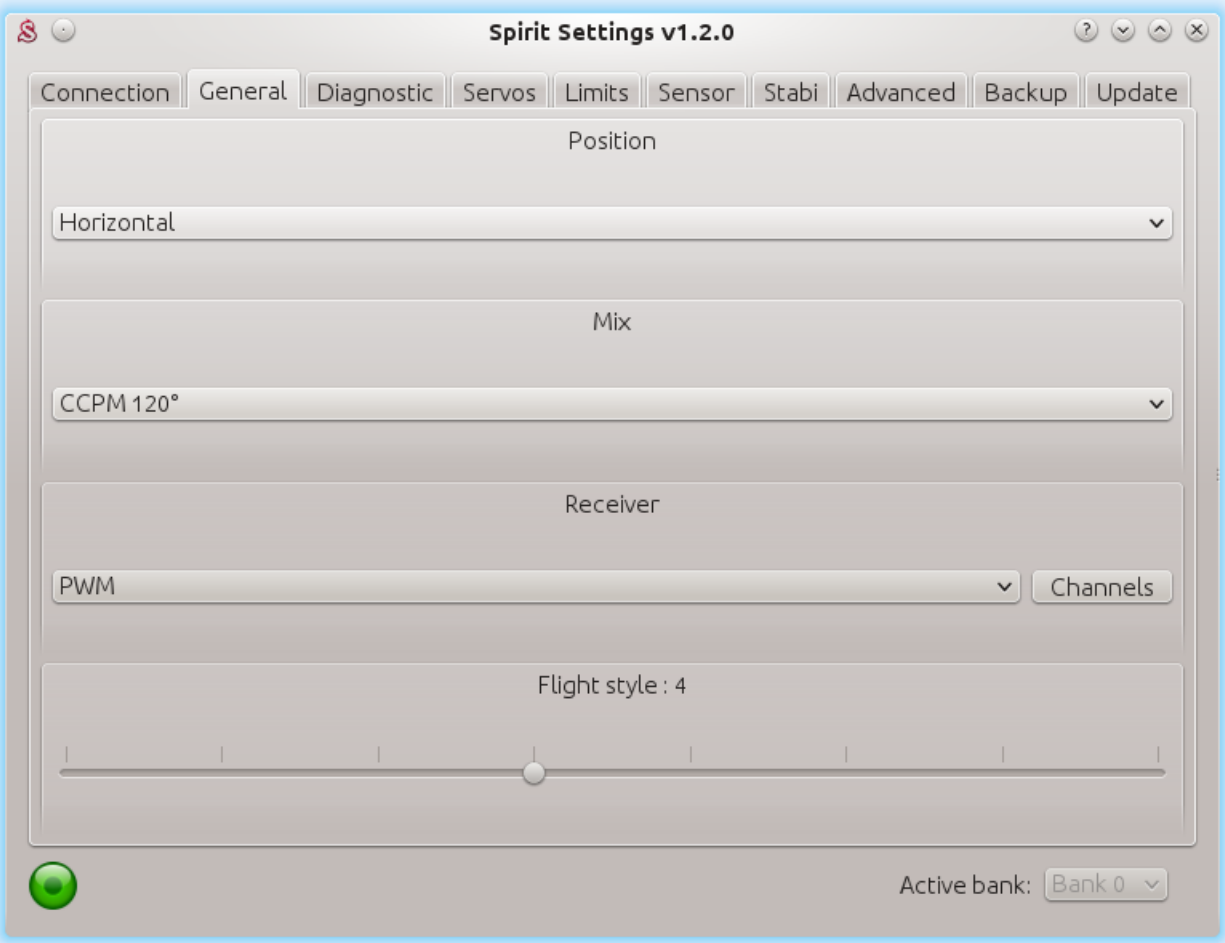
This tab indicates the current status of the connection, informs you about the current version of the firmware, displays the serial number of the connected unit and allows you to change the COM port. In addition it features a wizard for initial setup.



We recommend using this wizard, as it will guide you through a basic setup in the easiest and simplest way.

5.5.2. GENERAL

If you have already set up the unit using the wizard, you can make additional adjustments to your setup here. All values relate to the settings you selected in the wizard.



NOTE
Whenever parameters are changed, the new value is immediately applied but not saved. Unless settings are manually saved, after disconnecting the power supply all unsaved changes will be lost. (see Backup tab.)

Position
Selects the position in which the unit is attached to the model.
(See section 3 - Installation)

Mix
Select the swash type of your model. In most cases it is *CCPM 120°*.
Any swash mixing in the transmitter must be turned off. It must be set to H1 (single servo) type.

Receiver
Select the type of receiver you are using:
PWM – standard receiver.
PPM – single line connection.
Spektrum DSM2/DSMX – DSM2 or DSMX satellite.
Futaba S-BUS – receiver connected via SBUS.
Jeti EX Bus – receiver connected via EX Bus (for JETI model integration).
SRXL/SUMD – receiver connected via SRXL, SUMD, UDI.

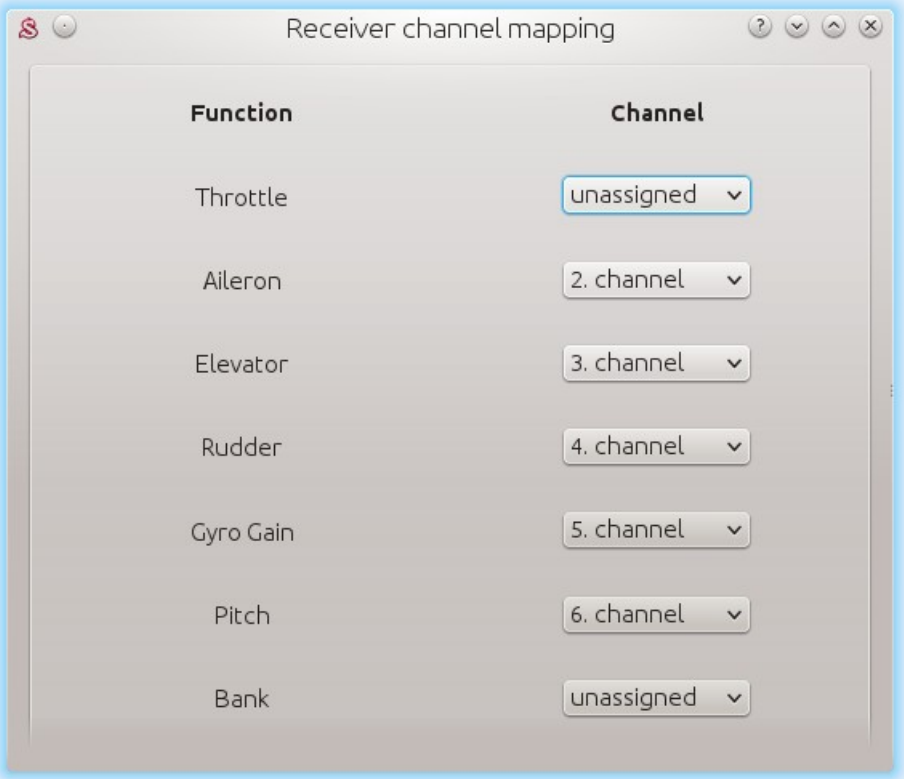
Flight style
Sets how the model will behave in flight.
This parameter is used to control and adapt flight behavior according to the requirements of the pilot.

Lower values mean that the model will behave in a more consistent, controlled manner and will feel more robotic.
Higher values mean a more natural behavior. The response to stick movements will be more flybar-like.

This parameter does not affect how stable the model will be.
Most pilots prefer default value - 4.

Channels
After clicking the button, the window with channel assignment is displayed. You can assign any channel to any function here. The number of available channels is dependent on the receiver type. Remember to only assign one channel to each function.

When a channel for *Throttle* function is assigned, throttle output from the unit can be obtained from the AUX position.
When a channel for *Bank* function is assigned, then Bank switching is activated (See chapter *5.6*).
When a channel for *Gyro Gain* function is unassigned, it is possible to configure gyro gain directly through this software in *Sensor* tab. The unassigned channel could be used in another way, e.g. for Bank switching.



5.5.3. DIAGNOSTIC TAB

Once the settings in the previous tab have been completed, it is now recommended to make any adjustments and changes required in the transmitter so that the transmitter controls match the displayed system's outputs.
Generally, each transmitter is different and the center of the channel is never exactly the same.
Wear and environmental influences can also have an effect causing the center of the channels to fluctuate.
Another consideration is the maximum and minimum value of each channel. Here, you adjust your throws using your transmitter's servo endpoint adjustments.

NOTE
For proper operation of the unit, it is necessary to check the values of aileron, elevator and rudder channels. These three channels must be centered at approximately 0%.
The unit automatically detects the neutral position during each initialization.
Do not use subtrim or trim functions on your transmitter for these three channels, as the Spirit FBL unit will consider these as an input command.
Ensure all subtrims and trims are zeroed.

It is also recommended to set the maximum and minimum values.
Test the minimum and maximum throws for all channels, if these values are not equal to -100% and 100% in the diagnostic tab it is necessary to adjust your transmitter endpoints to correct this.
You will need to adjust this for both directions using the dual rate, travel adjust and endpoint function in your transmitter.

Besides the aileron, elevator and rudder channels, it is also necessary to check the pitch channel. For this channel it is acceptable to use subtrim to achieve a center value of 0%.
When a collective pitch curve in range of -100% to 100% is used, the middle of the stick should show 0%.

After these adjustments, everything should be configured with regards to the transmitter.
If some channels oscillate around the center, it may mean wear of the transmitter potentiometers. This can be compensated for by increasing stick deadband in the Advanced tab. *(covered later)*

If the values in the aileron, elevator, or rudder channels are shown in bold, the system is recognizing a command to move/rotate the axes. Check your trims and subtrims to ensure they are zero or increase your stick deadband. *(Covered in the Advanced tab)*

To determine Gyro Gain and Mode of the rudder gyro you can check *Gyro* bar. Following modes are available:

- N – Normal (Rate)
- HL – Head Lock
- HF – Head Lock with active Function. *(Covered in the Stabi tab)*

SPECTRUM ANALYSER

The Spectrum analyser is a tool for measuring the amount of vibrations on your model.
It is a diagnostic tool designed to determine which rotating part is causing a problem. With this information you can easily identify and fix any problems with your model.

It is possible to measure vibrations in three separate axes:

- *Y – aileron axis*
- *Z – rudder axis*
- *X – elevator axis*

The live graph shows frequencies for the currently selected axis. This enables you to see both the frequency and magnitude of the vibration on the selected axis. Vibrations are transmitted to each axes dependent on several, various factors. Frequencies and magnitude are dependent on the model construction. Generally, the vibrations are the highest on Y axis (aileron) but we recommend you check all axes each time you are doing measurement.
However vibrations should not exceed 50% for all axes at any time.
In the case vibrations are at 90% or more, the model has an issue that needs to be rectified.
Should the magnitude exceed 90% on any of the given axes, it is recommended to fix whatever issue is causing these extreme vibrations before flying the model. Even though Spirit FBL unit is highly resistant to vibrations, these could cause unwanted interactions with the Spirit FBL unit and could also cause mechanical failure of the model. Such high vibrations can cause Loctite to fail and other mechanical parts to break.

Vibration levels:

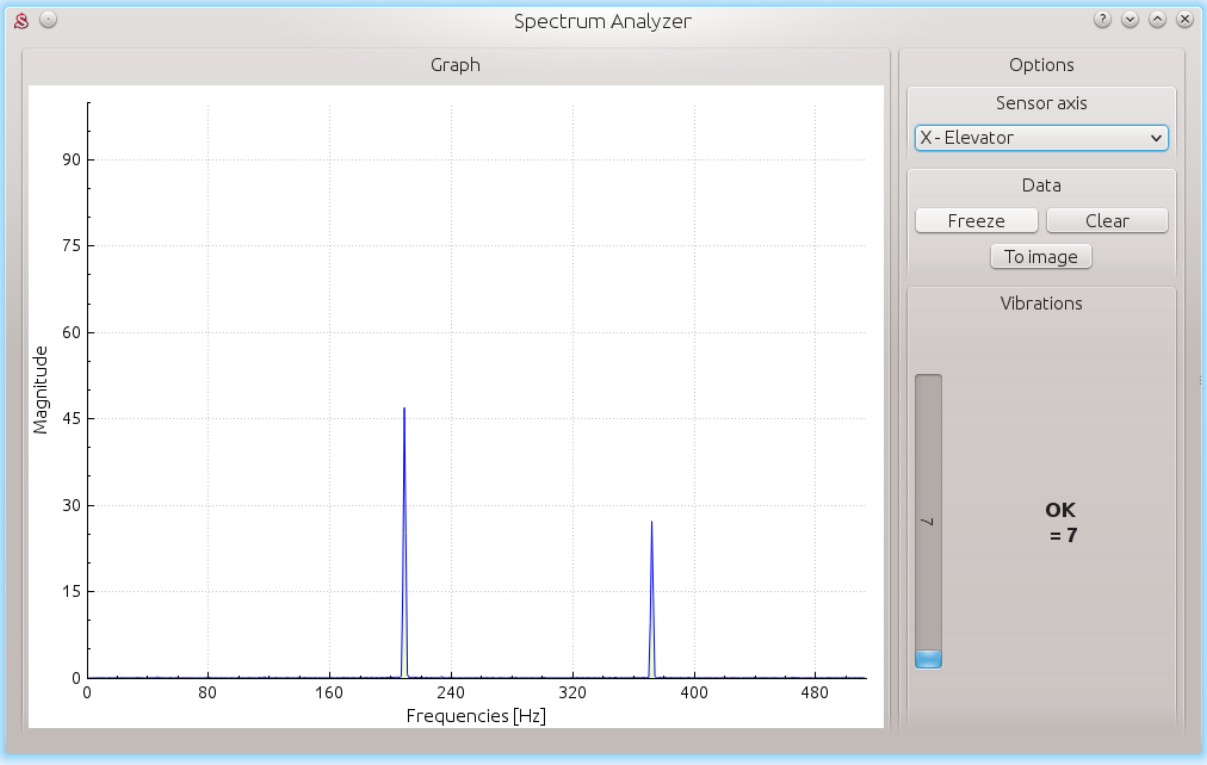
- Vibrations up to 50% - vibrations at a normal and acceptable level
- Vibrations between 50% and 90% - raised vibration levels
- Vibrations exceeding 90% - extreme vibration levels

As well as overall vibration levels not exceeding 50%, any specific frequency (peak) should not exceed 50%. Anything above this level should be cause for concern and requires further investigation.

For comparing the graphs, you can use the *Freeze* button. The current live graph is displayed and the graph captured using the *Freeze* button is saved and will be displayed as subgraph. This graph can be deleted with the *Clear* button.

It is possible to save the Spectrum analyser graphs. Using the *To image* button, the current graph will be saved as an image.

The Spectrum analyser is able to detect the vibration frequencies up to 500Hz (rotating parts at speeds up to 30,000 RPM).



Measurement procedure

1. Remove main and tail blades from the model.
2. Place the model on a suitable, soft surface (e.g. carpet, grass).
3. Set blade pitch at approximately 0° on both main and tail rotors.
4. Run the Spectrum analyser (this also freezes all servos).
5. Spin up the motor to the usual flight RPM.
6. Switch between the X, Y and Z axes, saving an image of each.
7. Check vibrations in all axes.
8. Stop the motor.

Recognizing vibrations
To recognize which component or part is causing abnormal vibrations it is necessary to determine the speed of the highest peaks. The main rotor will have the lowest speed and the tail rotor speed will be approximately 4.5x higher. Generally, the smaller the size of the model, the higher the headspeed will be.

In order to find out which part of the model is causing the unwanted vibrations, move cursor to the peak and check the head speed (RPM). The speed of the main rotor is usually in the range of 1500 to 3500 RPM. Therefore, if the speed is within this range, it is likely that there is a problem with the main gear, main shaft, main shaft bearings or rotor head itself.

Most excessive vibrations are usually, although not always, tail related. To check if there are vibrations coming from the tail you should find the frequency peak that is approximately 4.5x higher than the frequency of the main rotor.

Once you identify which part of the helicopter is causing the unwanted vibrations, you can gradually remove components of the suspect assembly, repeating the measurement process until the vibration disappears.
Once the vibration levels have dropped to an acceptable level, you have found the suspect component and can replace it.

Measuring with tail blades installed carries some safety concerns and will also show increased levels of vibration.

NOTE
Gasser motors shouldn't be operated without load! Vibration measurement can't be performed without blades.

BEC TESTER

The tester is used for determining whether your power supply for the unit, receiver and servos is sufficient.
The purpose is to achieve the biggest current spike and verify that your supply voltage will not drop under the safe level.

Click the *Start* button to start the test. After 20 seconds it should be finished.
If you will observe any issue, then your power supply is insufficient and should not be used. In this case power supply with higher current rating should used.

LOG VIEWER

The log is used to record events during flight. If a problem occurs and the reason isn't immediately known or evident, checking the log can help in identifying the issue.

It works in such a way that it records various events from the time the unit is powered on. If an event occurred you can see this in the log, reporting to the log is done every 10sec. When you click the *Open log* button you can see the current flight log which contains all the events from the last flight. When the power is disconnected, the log is cleared.

In the case of a major problem occurring during the flight , the log is then saved permanently to the unit's memory and remains there until such time as the log is opened.
If there is a saved log in memory, the user is advised with the message "Log from previous flight is available!" and the log from the flight when the problem occurred is opened. For example, when a signal is lost or the power supply failed you can find this in the log. The log from the first flight where the major problem occurred is always saved. If this is not opened, then it will not be overwritten with a newer one. In this state, the user is also notified by different cyclic pitch pump during the initialization process.

The log can contain the following events:

Good Health Message:

The model is in good condition. The unit did not recognize any problems.

Calibration Finished:

Sensor calibration was successful.

Governor was Engaged:

Governor achieved requested RPM and is active from this moment.

Cyclic Ring Activated:

Cyclic achieved its maximum tilt angle. This indicates the model was unable to do the desired correction as necessary. In most cases it is not relevant. But it is possible that the value of the Cyclic Ring parameter is too low and the model can't rotate as fast as intended in the aileron/elevator axes. Alternatively, a too high value for rotational speed could be configured. It is also possible that in fast forward flight the model can pitch-up rapidly. We recommend to set this parameter as high as mechanically possible.

Rudder Limit Reached:

The rudder servo reached its configured limit. When this event occurs before or after a flight it is not a problem. If you see this during flight it indicates that the rudder did not operate correctly. In most cases it is visible during flight as poor rudder response or "blow out".
If the model is set up correctly then it could be due to low rudder efficiency such as the tail blades being too short or headspeed too low. There is also the possibility of a mechanical issue or with the rudder limits being inadequate.

Receiver Signal Lost:

Signal lost suddenly. This problem should not occur at any time and must be resolved before the next flight. There could be a problem with the receiver and/or transmitter antennas. It could be a faulty receiver cable or the connection between the unit and receiver. In some cases signal loss can happen because of electrostatic discharge caused by static build up, this usually occurs in belt driven helicopters.

Main Loop Hang Occurred:

The main loop was delayed. This can happen when wiring is incorrect or there is abnormal electrical noise interference with the unit, for example, from a BEC. If using the configuration software it could mean the link to the Spirit FBL unit is slower than it should be.

⚠ Power Voltage is low:

Power supply voltage is lower than 2.9V. This mean you have to use 0 a BEC that is capable of handling higher loads. In rare cases it could be faulty connections in cables.

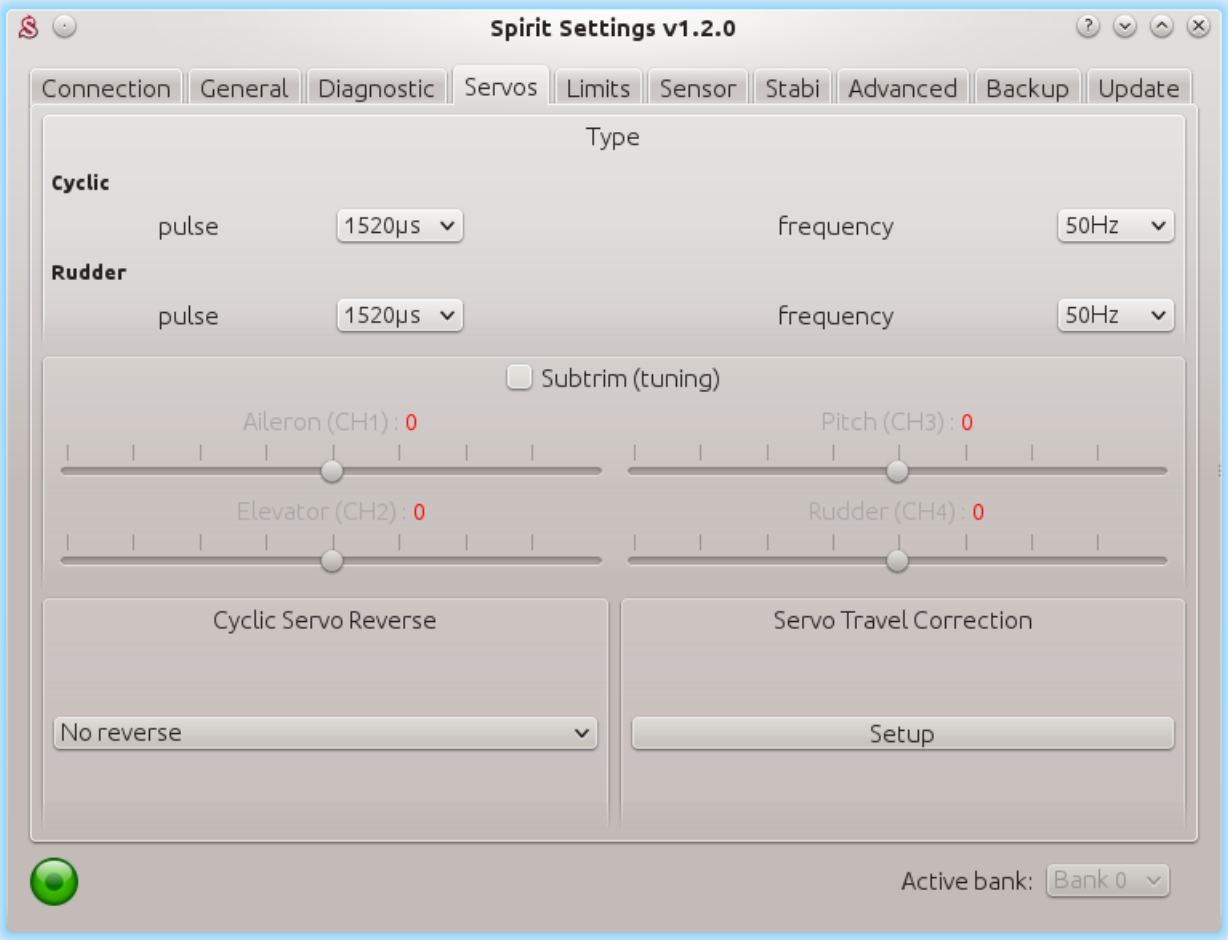
⚠ Vibration Level is very high:

Vibration level achieved the level that is not normal and can affect integrity of the helicopter. During hard 3D maneuvers the event can occur more frequently.

All reviewed logs are saved as PDF files into Documents directory.

5.5.4. SERVOS TAB

This tab is used for servo configuration, care should be taken to ensure correct frequencies are used and that the directions are set correctly.



Type
In this section, set the values for neutral pulse and frequency according to your servo manufacturer specifications.
For analog servos the frequency is usually a maximum of 60Hz.

Subtrim (tuning)
Ideally, without the rotor head installed, use a swash leveler to align the swash and servo horns so that the swashplate and servo horns are horizontal and perpendicular to the main shaft.
This is done by ticking the item Subtrim (tuning). This will put the Spirit FBL unit into a special mode where the collective position will be neutral with the servos centered. In addition, stabilization will be disabled.
Servos can easily be adjusted at this time. When completed, the swashplate should be exactly perpendicular to the main shaft and in addition collective pitch should be at 0° (it is possible to measure the pitch angle using a pitch gauge with rotor head and blades attached).

In most cases, it is also necessary for servo horns to be perpendicular to the main shaft.
All servos, i.e., CH1, CH2, CH3 and CH4, are set separately on individual sliders. CH1 and CH3 are the aileron servos. CH2 controls the elevator and CH4 controls the rudder.

It is also necessary to set the subtrim and mechanics of the rudder so that the servo horn is perpendicular to its case and rudder pitch is at 0°.
This setting will affect rudder stop performance.

Once set up, un-tick the Subtrim (tuning) check box to turn off this special mode.

NOTE
After exiting the special mode, stabilization and rudder will work again.
Be sure your collective pitch channel is configured correctly in the transmitter. That means you should see -100% to 100% in the diagnostic tab.
Double check that 0% in diagnostic tab corresponds with middle position of your collective/throttle stick (with linear -100% - 100% collective pitch curve).

Cyclic servos reverse
This allows you to choose which servos should have their direction of motion reversed. While changing the collective pitch all servos should move in same direction.

The options available are:
Without reverse – all servos without reversing
CH3 – CH3 servo reversed
CH2 – CH2 servo reversed
CH2 & CH3 – CH2 and CH3 are reversed

If you cannot obtain the correct collective direction of travel in this section, try reversing your pitch servo in your transmitter and then adjust your channel reversing in the software as necessary.

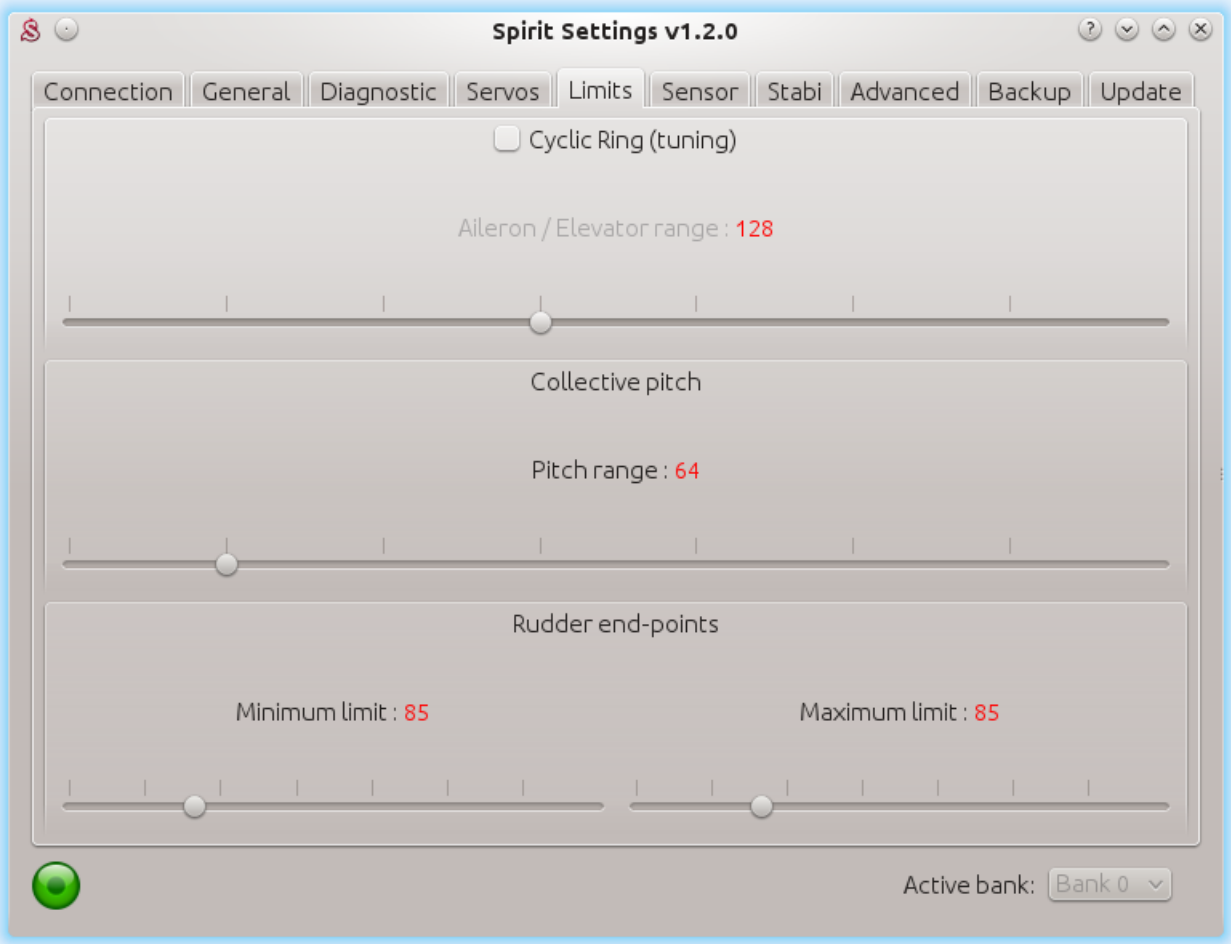
Servo travel correction
Here, you are able to modify and correct travel for each servo individually. Some servos are not very accurate in regards to travel at their limits and this inaccuracy may have a negative impact on flight characteristics. Once in this section of the software, the unit switches to a mode for doing these corrections.
It is expected that in the previous step, *Subtrim (tuning),* the swashplate was set at zero collective (0° rotor blades pitch).
The procedure is such that you should use a swash leveler to determine whether there is any deviation on any of the servos in the lowest and highest points of collective throw.
For both high and low positions, it is necessary to set the values separately – this is the reason for 6 sliders. If the travel is less than required, increase the value. If too much, decrease.
To activate sliders in the secondary part move your collective to opposite direction.

This correction is also useful if there is asymmetric geometry on the helicopter causing issues such as the inability to achieve equal positive and negative pitch values. In this case, it is necessary to modify the minimum or maximum for all three servos.
If you are unsure about your settings, it is better to leave the sliders in the Middle. (position 0)

Servo Travel Correction
Col.
Aileron (CH1) : 0
Elevator (CH2) : 0
Aileron (CH3) : 0
Maximum
Minimum

5.5.5. LIMITS TAB

This tab affects limits and servo travel ranges.



Cyclic Ring (tuning)
This parameter sets the electronic cyclic ring, which allows the model to achieve the largest cyclic ranges without mechanical binding (binding of servo horns, pushrods and linkages).
This parameter acts as a so-called electronic *Cyclic Ring.*

NOTE
The settings here should be done very carefully to avoid damage to the model or it's associated electronics.

First, set your desired collective range, for example, +/-12°. We recommend using a -100% to 100% linear collective pitch curve in the transmitter.
Now it is time to set the Ail/Ele maximum cyclic pitch range. Try to set the largest possible deflection. This parameter does not directly affect the speed of rotation, but if it is too low, the model may not have consistent pitch and roll rates.
This setting should be done with 0° collective pitch. Then carefully check maximum stick deflection in all directions to ensure that mechanical binding does not occur.
This should also then be done with maximum and minimum collective pitch.

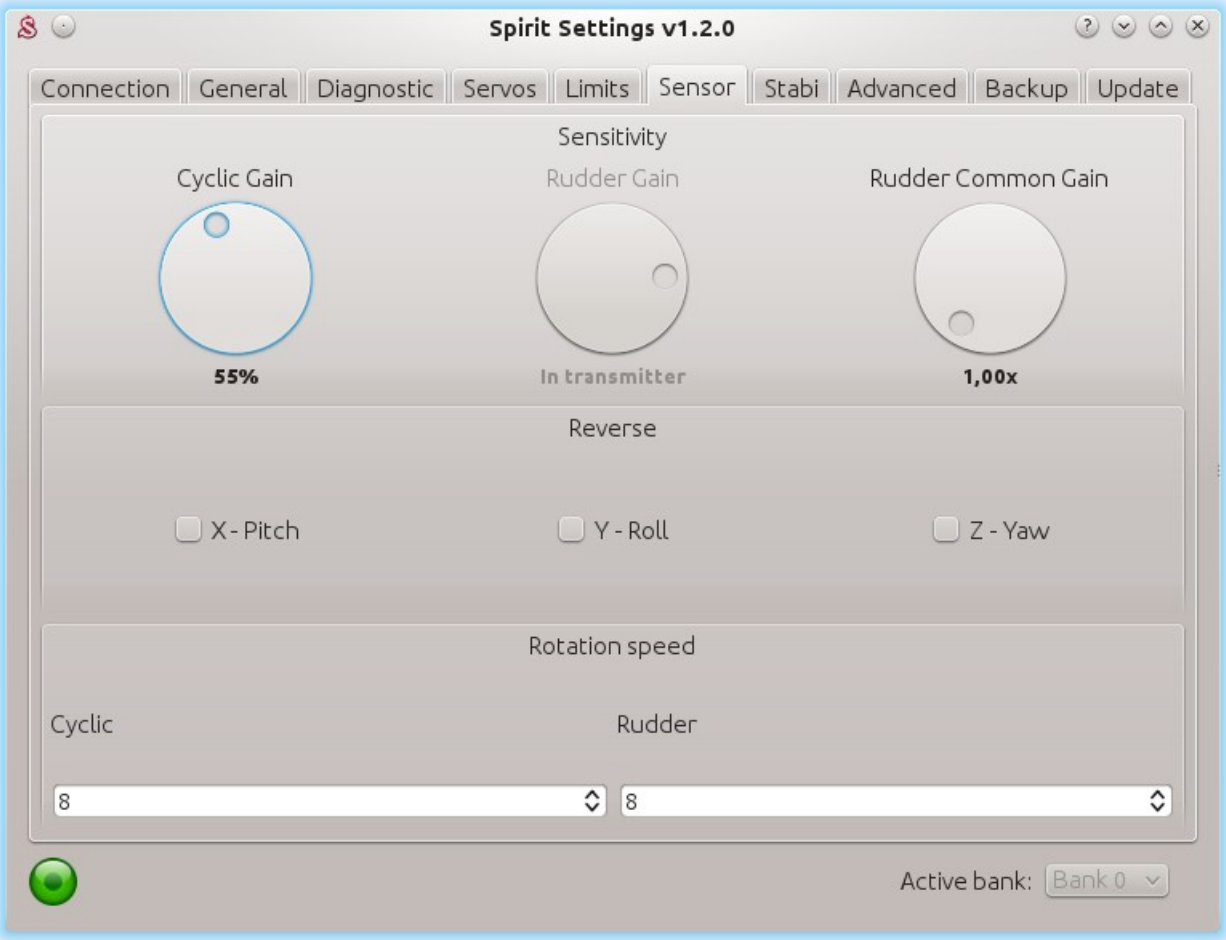
If you increase the collective pitch range, this parameter must then be checked and in some cases adjusted to insure no binding occurs at your new maximum and minimum pitch ranges.
If the selected cyclic ring range is insufficient, it is possible that pitch-up can happen during fast forward flight (even if the pitch-up compensation is at its maximum value). This is because the model will not be able to add sufficient corrections with the configured range.

Rudder end-points
Minimum / Maximum – Sets the minimum and maximum deflection of rudder rotor blades.

We recommend setting these values for both directions to the maximum allowed range by the manufacturer of the helicopter. Otherwise, the rudder may not be able to keep the yaw direction during demanding maneuvers and tail blow outs may occur.
For the easiest way of the configuration we recommend to use Head-Lock gyro mode (positive Rudder Gain).

5.5.6. SENSOR TAB

This tab is the last important part of the settings which must be configured.



Sensitivity
The rotary dial adjusts the gyro sensitivity for aileron, elevator and rudder axes.

Cyclic gain – The higher the value is, the higher the accuracy within the control loop.
The default value is preconfigured to 55% gain, for most models an optimal value of around 60% is suggested.

Rudder Common Gain – 100% means no multiplication. This is the recommended value for 550-class helicopters and smaller. For bigger helicopters it is often higher. 130% could be fine. Transmitter gyro gain should be configured to approximately 60% for the first flight.

Rudder Gain – This parameter is enabled only in case of unassigned Gyro gain channel. It replaces function of Gyro gain from the transmitter, so you can directly set the value in the software.

Rudder Gain in the software or in your transmitter can be programmed in this way:

- Head-Lock mode: 1% to 100%
- Normal (Rate) or a special function: -100% to 0%

Negative gyro gain can be used to activate the rescue or the stabilisation modes – check the Stabi tab.

Reverse
Sets compensation direction for each axis separately.
The swashplate should tilt as if trying to stay level.
Rudder blades should compensate to opposite direction as you rotate the model.

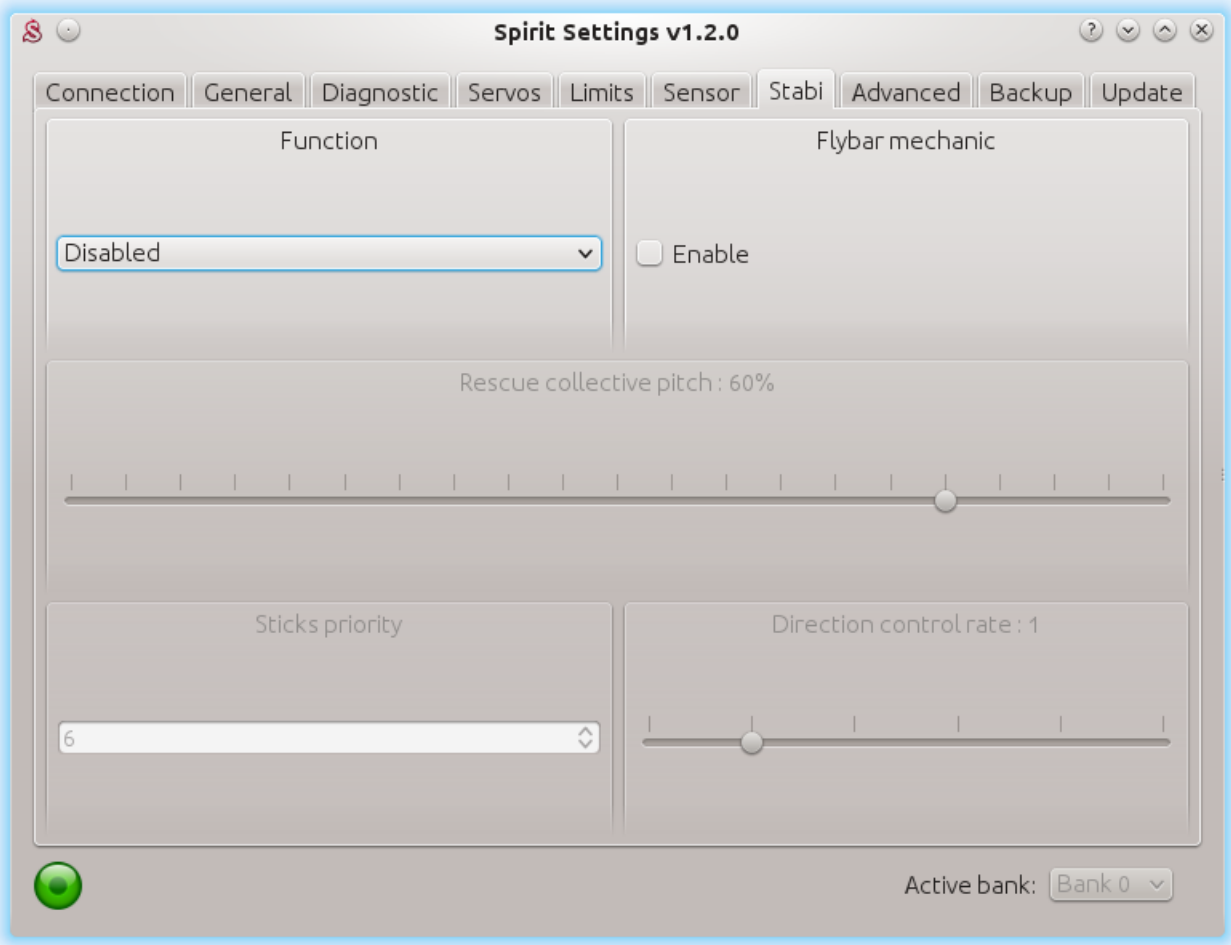
NOTE
This parameter is the most important one, it is necessary to carefully check the orientation of compensation and set it correctly. If this is set incorrectly, the Spirit FBL unit will compensate in the wrong direction, more than likely causing a tip over on spool up.

Rotation speed
The default value is 8 and will favor beginners more, the higher the value, the faster the rate of rotation. This factor also depends on the mechanical linkage ratio or D/R (Dual Rate) in the transmitter and also on the Aileron/Elevator limit. We recommend to set this parameter within a range of 6 -12. Remember that DFC rotor heads tend to rotate faster so it's better to initially start with a lower value for them.
Make sure the value is not too high else it can cause unwanted and inprecise movements.

5.5.7. STABI TAB

The Spirit unit offers you the options of model stabilization and rescue mode.

The stabilization function, once activated, will recover the model to a horizontal position without any other input from the pilot, this can be used as a "bail-out" feature when trying new maneuvers and can help with the learning process.



Rescue mode complements the normal operation of the Spirit unit.
If activated, the model will recover to a horizontal position and add collective pitch as per the settings. This function can be used any time when the pilot loses orientation or control of the model.

The Spirit unit allows you to assign a stabilization or rescue mode using the gyro gain channel. 0 - 100% gain in the transmitter is always heading lock gyro mode and with -100 – 0% gain, you are able to activate stabilization or rescue mode.
This means that instead of normal (rate) mode, it will stay in heading hold gyro mode, plus rescue/stabilization is activated.
So, while rescue/stabilization mode is activated, a gyro gain of -70% is considered as 70%.
This behavior can be also observed in the Diagnostic tab.

NOTE
Some transmitters have a gyro range of 0 to 100% where 50% is the middle - zero gain (e.g. Spektrum DX6i). Others use a range of -100% and 100%, where 0% is the middle.

Function
Here is where you select which mode should be activated at negative gyro gains.

Disabled - Normal (Rate) gyro mode.
Rescue (normal) - Recovers the model to an upright horizontal position – skids always to the ground.
Rescue (acro) - Recovers the model to a horizontal position, inverted or upright, whichever is closer at the time of activation.
Stabilization (normal) – stabilization mode - skids always to the ground.
Stabilization (acro) – stabilization mode - inverted or upright, whichever is closer at the time of activation.

WARNING
In case that pirouette optimization is not configured correctly the rescue and stabilization mode will not work properly!
If using these modes, be sure your helicopter is initialized on a flat surface, not tilted to any side.

The rescue mode is very demanding on the BEC. Be sure your BEC can handle such peak loads. In case it is is not sufficient your model could crash!

Flybar mechanic
If your helicopter is equipped with traditional flybar mechanics, you have to enable this parameter in order to use the stabilization or rescue modes.
All settings are the same for flybarred helicopters except this parameter.

NOTE
Flybarless helicopters must be configured and operated with the Flybar mechanic parameter disabled.

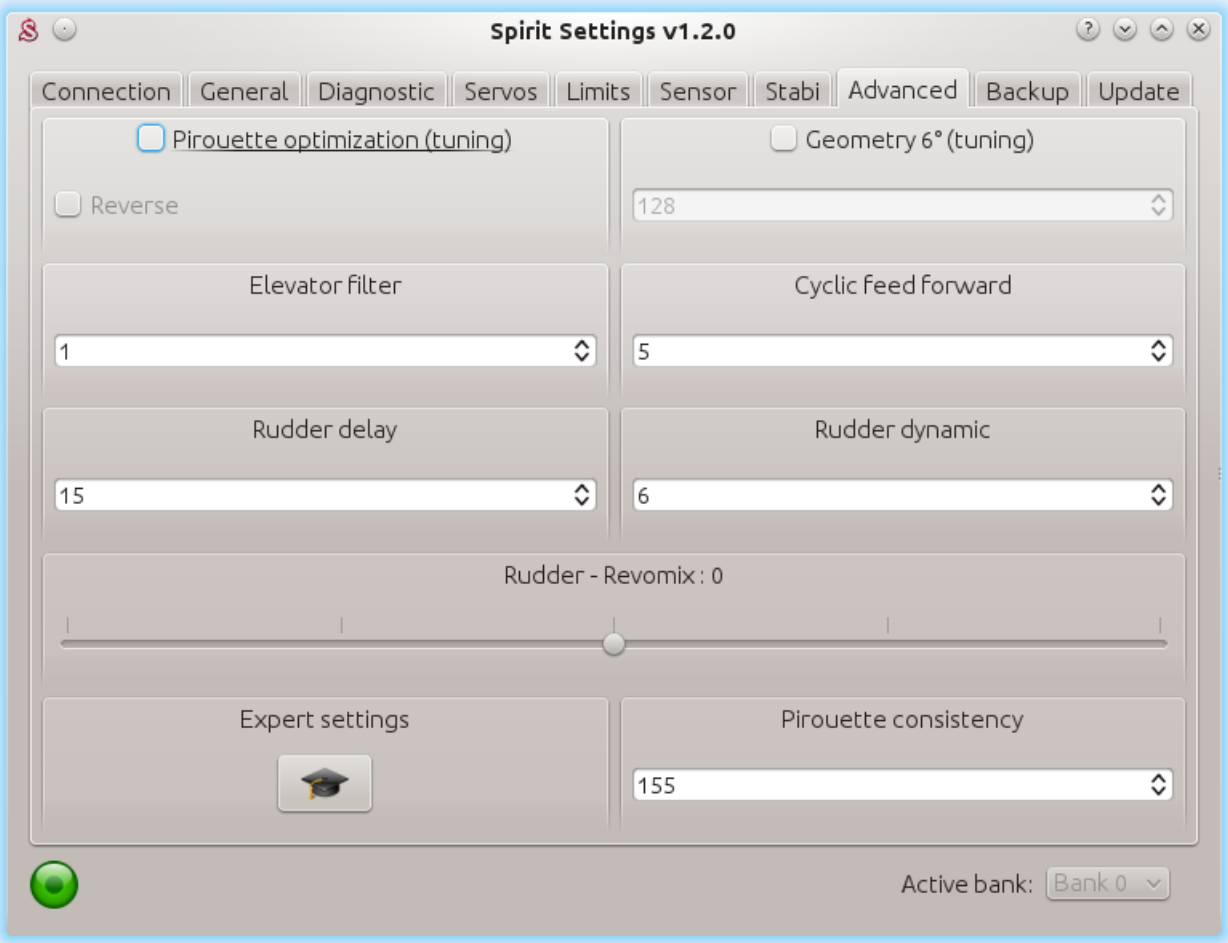
Rescue collective pitch
This determines how quickly the model will recover to a horizontal position.
100% means the maximum deflection of the blades, which was configured in the Servos tab.
It is very important to check whether the rescue mode works correctly before the first flight (on the bench without the motor/rotors running), i.e., whether the direction of collective pitch is correct. If collective pitch is not positive while helicopter is on the ground, you have to change to a negative value for this parameter.

Sticks priority
Specifies the amount of control while configured mode is activated.
The higher the value, the more the model will react to stick movements.

Direction control rate
This specifies the rate of controlling direction for the stabilization mode.
Low values are well suited for beginners to get coaxial like behavior.
Higher values are more appropriate for scale flying.

5.5.8. Advanced tab

This tab is for more advanced configuration of the Spirit FBL unit. It is recommended that you fully understand these parameters before adjusting them. However, it is essential to set pirouette optimization and geometry. Other parameters, however, depend on the preferences of the pilot.



Geometry 6° (tuning)
For proper operation of the Spirit unit, it is necessary to set this parameter correctly. Here, the unit is switched to a special mode for settings 6° of cyclic pitch on the main blades. It is necessary to set the value so that the blades angle is at 6° in the aileron axis. You need to rotate your rotor head with blades to be parallel to the longitudinal axis of the model.
A higher value increases the angle; a lower one decreases the angle. Optimal head geometry should be in the range of about 90 – 160. If not in this range, it is recommended to adjust the distance of a ball link on the servo horns or perform other mechanical adjustments.

Pirouette optimization (tuning)
If this parameter is ticked, the unit enters a special mode in which you must test and set the correct compensation direction.

Holding the model by the rotor head, rotate it around the yaw axis as if doing a pirouette.
The swashplate should stay tilted and pointing in the same direction, it should behave like a compass. That means, the swashplate should be tilted at all times, pointing in one direction while you rotate the helicopter.
If it does not behave like this, reverse the setting.
If this parameter is not configured correctly, your model will not perform stationary pirouettes without additional inputs from the pilot.

When settings are completed, you can easily untick this parameter to exit the special mode.

Elevator filter
This parameter compensates elevator bouncing during aggressive maneuvers. The larger the value, more compensation is involved.
If this value is too high it can lead to a soft feeling in the elevator.
We recommend using the default value of 1 to begin with.

Cyclic feed forward
This parameter is used to set amount of direct feel between your sticks and your model helicopter. The higher the value, the more aggressive the model will feel and the faster the model will react to stick movements.
Setting this value too high can result in elevator bounce.
If the model feels disconnected and there is a lag between stick inputs and the model, try increasing this value.

Rudder delay
This is a parameter to smooth rudder movements. It also helps to stabilize the rudder – it is a kind of electronic damping. The faster the servo is, the lower the tail delay should be. For analog servos it is recommended to set this value to around 20-25. For usual digital servos it is mostly between 10 – 15. For very fast servos (~0.04s/60°) the value is 5. In case of a brushless servos it is recommended to set a value of 0 - 2.
If the value is too high, the rudder could start to oscillate or wag or could cause a slow rudder stop.

Rudder dynamic
If the rudder does not stop correctly, for example it overshoots, this behavior can be changed with this parameter.

6 – is the default value.

The larger the value, the more aggressive the behavior of the tail.
If the tail overshoots in stops, the value is too high.
This parameter also affects the response speed of the stick movement; a higher value means a faster response.
If you cannot reach a symmetric stop on both sides you will need to make sure that the tail is centered at 0°. Alternatively, you can lower the rudder limit for that side.

Rudder – Revomix
Revomix (tail pre-compensation) adds rudder in response to collective pitch changes, when the tail needs increased holding. Revomix is independent of the transmitter.
By default it is turned off, the user must set the amount required and the direction of the pre-compensation.
The correct direction is determined by the correction needed at full positive or negative pitch to compensate for the main rotor torque. In most cases, the main rotor rotates in a clockwise direction.
Allowed values are -10 to 10 with 0 being disabled; in most cases it is not necessary to use this parameter, however, when using low headspeed or on helicopters with a poor performing tail, this setting can be used.

Pirouette consistency

This parameter determines the consistency of pirouettes and holding performance. If pirouettes are not consistent during certain maneuvers, increase the value of this parameter.

This value is individual for every model, it depends on many factors such as: your rudder mechanics, head speed, etc. Before setting this parameter, it is recommended to first set the gyro gains.

If the value is too high, the tail can oscillate or wag. It can also cause poor stop performance. This value should be between 150 and 180.

For brushless servos it is recommended to increase value by 10-15 points.

EXPERT SETTINGS

For fine tuning you can set the following parameters. Normally it is not needed to configure any of these parameters.

Stick deadband

Determines the area, around center stick, where the system does not recognize any stick movement. If channel readings are inprecise the value should be increased. This can be verified in the Diagnostics tab.
This parameter does not replace the Exponential function.

Elevator pitchup compensation

If, during fast forward flight, the model reacts to inputs too rapidly or if the model pitches up, increase this value until this no longer occurs.
If the helicopter pitches up abruptly, this could be caused by a cyclic range that is too low and/or too much collective pitch.
In this case, you will have to increase the *Aileron/Elevator range* as high as the model can handle without any binding. If this doesn't fix the problem, you can add more pitch-up compensation.

Cyclic phase

The value indicates the angle by which the swashplate is virtually rotated.
For example a value of 90 will rotate the elevator to aileron. This feature is recommended for models with multi-blade rotor heads. For most other models, we recommend a zero value.

Pitch Pump Booster

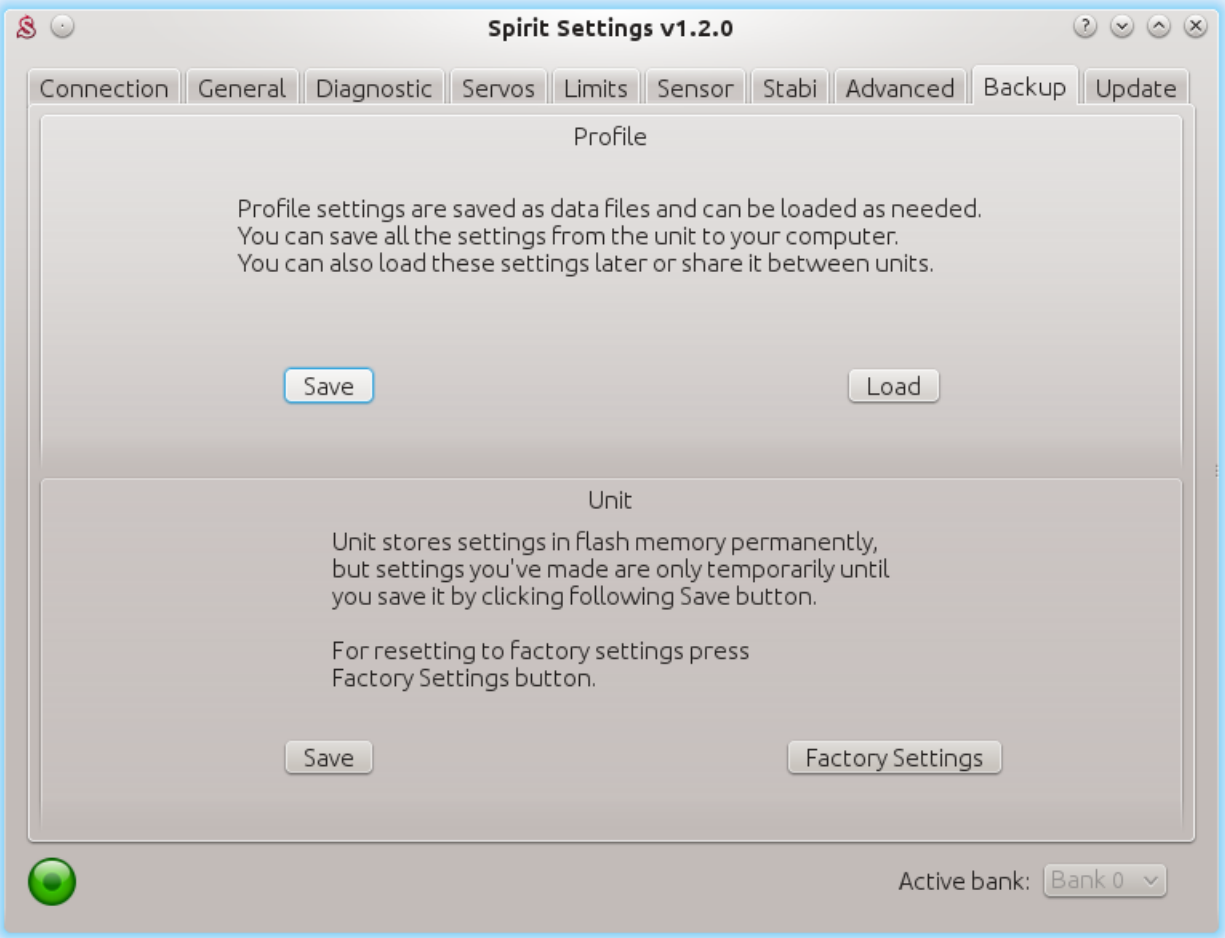
To achieve flybar-like collective pitch behavior, you can increase the value until desired feeling is achieved. Remember that higher values are too demanding for power supply and servos on the model.

Signal processing

This parameter is used for operation on models with extreme vibrations that can't be eliminated in any way. This should be enabled only in cases when is absolutely necessary, because flight performance could be affected.
It should increase precision of flight and also the precision of rescue and stabilization modes.

5.5.9. BACKUP TAB

Here, you can save the settings to your Spirit unit before powering off, you can also save the settings to your computer here, Should you need to reload them at a later date.



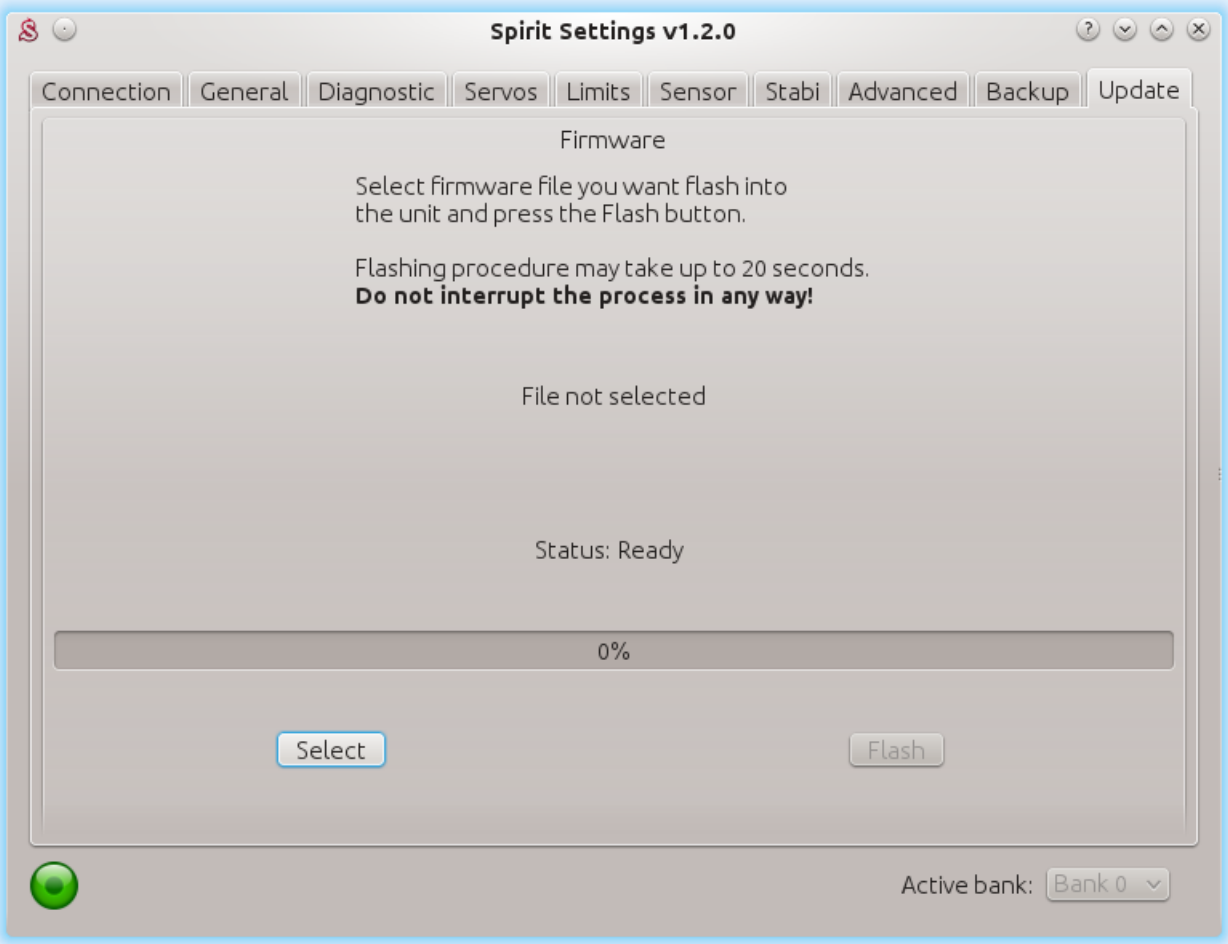
Profile
This section allows you to *Save* and *Load* complete settings of the unit to a specified file.
If you have more than one of the same model, it is not necessary to carry out a complete setup again, just load the stored settings easily with the *Load* button.

Unit
Any changes to the configuration can be saved at any time to the internal flash memory of the unit.
To put all settings to a factory defaults, click *Factory* Settings.

NOTE
Remember to save the settings each time you want to store the settings permanently. You must press the *Save* button. Otherwise, the changes will be lost after the Spirit FBL unit is turned off.

5.5.10. UPDATE TAB

If you want to update the firmware, you can do so in this tab.



Firmware
First select the data file containing the firmware (*. bin) – *Select* button.
You can get firmware from: spirit-system.com.
Once the file is selected, press *Flash.*
The upgrade progress will be displayed here. After completion, a confirmation dialog box should indicate a successful update.
Then, unplug the unit from its power source.
Upon the next start it will load with the newly flashed firmware.

Configuration of the unit is not changed, so you do not need to save/load it.

5.6. BANK SWITCHING

This functionality allows you to switch between saved settings during a flight. Switching is done through the transmitter, so that channel's value is changed. This mean that a Bank can store one unique settings. The unit is able to store 3 different banks.

With a transmitter you are able to use a three position switch to switch freely between banks.

Bank switching is disabled by default, so you can decide whether it is useful in your application. You have to activate it by the assignment of *Bank* function in the *General/Channels* window. Generally, it is assigned to channel 7.

Bank 0 – active in range of lower third (impulse under 1400µs).
Bank 1 – active in range of mid third (impulse between 1400µs to 1640µs).
Bank 2 – active in range of upper third (impulse above 1640µs).

Initial settings for Bank 1 and Bank 2 are equal to Bank 0. Bank 0 allow you to configure all parameters, while Bank 1, 2 does not allow to set main parameters. For safety, Bank 1 and 2 does not allow you to set any main parameters.

The Bank switching is great for switching between flight styles, sensor gains for low or high RPMs, for slow acro or 3D. Alternatively it can be used just for tuning your settings.

If the software is connected with the unit then bank switching via the transmitter is disabled. Then, Bank switching is performed using the software in bottom part of the window.
When a bank is switched using the software it is necessary to save your settings to the unit before you switch Banks, or your settings will be returned to the previous (unchanged) state.

5.7. GOVERNOR

From firmware version 1.2 governor feature is available!
You can use this feature instead of internal governor from your ESC or other governor. It is designed to work with electric, nitro and gasser helicopters. This can make flight performance even better because of constant head speed.

To achieve proper function it is very important to configure your ESC and then the unit. First from all make sure that internal governor is disabled in the ESC.

It is necessary to disassemble rotor blades from your model prior to the governor setup. Do not make any adjustments with motor turned on.

Governor feature can be used with the following receiver types:
Spektrum DSM2/DSMX, Futaba S-BUS, Jeti EX Bus, SRXL/SUMD

It is necessary to use throttle output from the unit when using governor. Throttle output is at the AUX port. You must connect the ESC or throttle servo there.

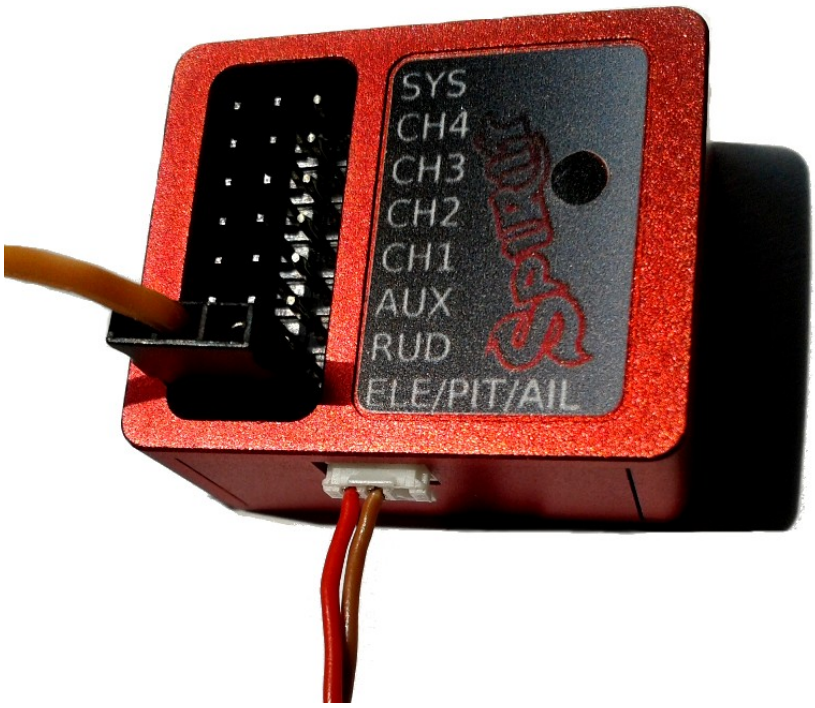
5.7.1. Sensor Wiring

Signal from a RPM sensor should be connected to the PIT pin (middle pin of the ELE/PIT/AIL port).

- **ESC with RPM output**
  For electric helicopters the best and the easiest solution. You can use RPM output cable that is present on the ESC.

- **ESC without RPM output**
  In case that your ESC has no RPM output you will need a separate RPM sensor that can be connected to phases of the motor.
  Important is to power the sensor properly. Voltage can't exceed allowed level for the sensor. Recommended voltage range can be obtained from the sensor manufacturer. In case that the sensor require 3.3V you can connect it to the satellite connector in the unit (Details in the following photo). You can also use the Spektrum adapter.
  In case that the sensor is powered improperly it can be damaged along with the unit.

- **Magnetic sensor**
  In case that your ESC has no RPM output you will need a separate RPM sensor that can be connected to phases of the motor.
  Important is to power the sensor properly. Voltage can't exceed allowed level for the sensor. Recommended voltage range can be obtained from the sensor manufacturer. In case that the sensor require 3.3V you can connect it to the satellite connector in the unit (Details in the following photo). You can also use the Spektrum adapter.
  In case that the sensor is powered improperly it can be damaged along with the unit.



RPM Sensor connection with optional power from the satellite connector.
Red (+3.3V), Brown (GND).

5.7.2. Prerequisites

Electric
1. Set throttle range in your transmitter so that 0% and 100% throttle position matches with value of the throttle bar in the diagnostics tab. This can be done by Subtrim function in your transmitter and/or Travel Adjustment function.
2. Re-calibrate throttle range according to instructions of your ESC. In the most cases it can be configured by powering the model with throttle stick with 100% throttle and then by moving the stick down to 0%.
3. If possible, configure fast spoolup mode in the ESC so the governor will be unaffected.

Nitro / Gasser
Set the throttle range in your transmitter so that 0% and 100% throttle position matches with value of the throttle bar in the diagnostic tab. This can be done by Subtrim function in your transmitter and/or Travel Adjust function.

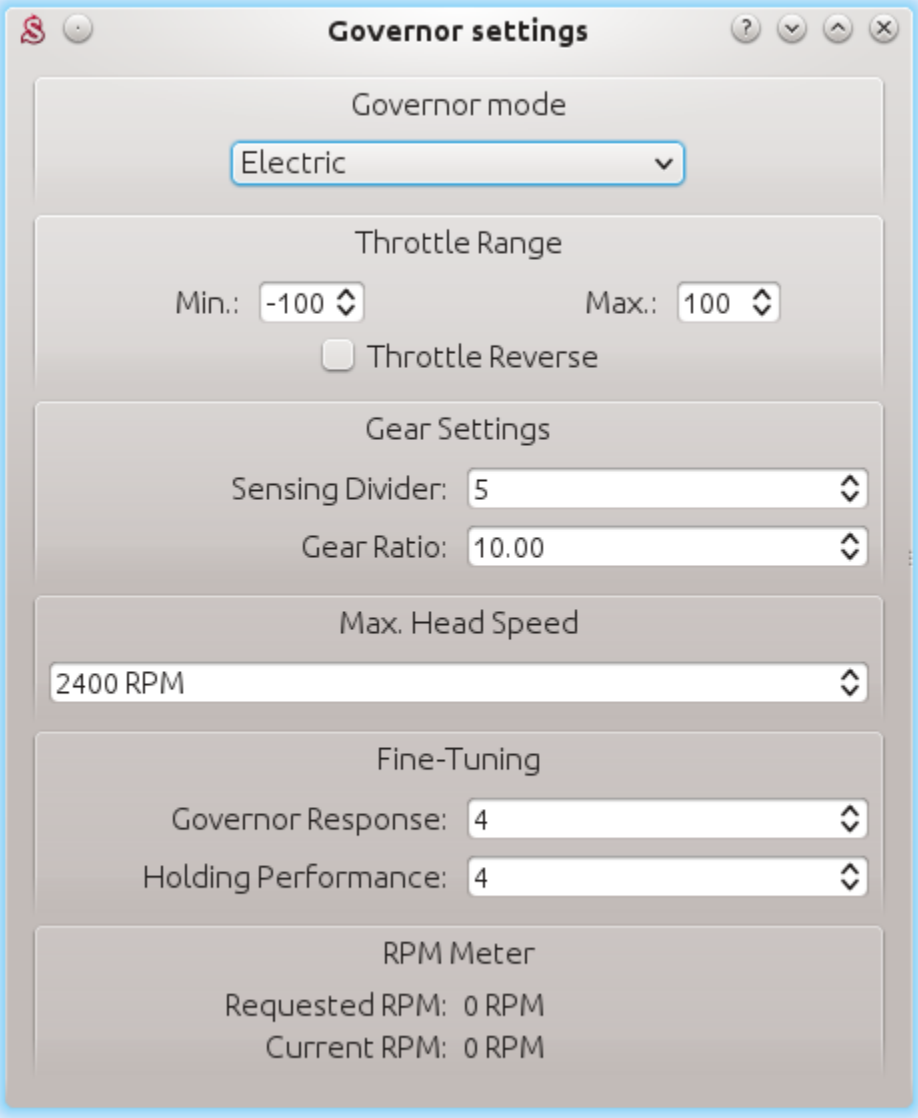
5.7.3. Activation

To activate Governor feature in the unit, you will need to assign Throttle function in the General tab/Channels. Then you will be able to enter Governor Settings in the General tab.

In the Governor window you can select Mode which do you prefer.

5.7.4. Settings

First from all basic settings are necessary so the governor can calculate head speed correctly.



Governor mode
Select which mode do you prefer:

- Electric
- Electric (Fast spoolup)
- Nitro/Gasser
- Nitro/Gasser (Fast spoolup)

For helicopters with electric motor we recommend to set *Electric*. For Nitro and Gasser motors select *Nitro/Gasser*.
If you prefer fast head speed spoolup (3 - 5s) you can use *Fast spoolup* option. For the initial setup we recommend normal option.

Throttle Range
This parameter can affect output from the unit so you can fine-tune ranges precisely. For electric helicopters this parameter is optional. But in case that your ESC does not allow to calibrate throttle range correctly, you can do so here.
For Nitro and Gasser helicopters you have to configure it always so the Throttle servo range matches range for the motor.

Min.
You should start with Min parameter which is working as a Subtrim for the Throttle servo. You should set the lowest position when the motor is not spinning up anymore – is halted. While configuring this, the motor can start so you have to be very carefull.

Max.
This parameter determine the highest position of the output. If this parameter is not high enough you will be unable to tune Governor because there is not enough room to compensate high loads. So it should be configured to match with 100% throttle output programmed in your ESC or full throttle of the motor. If configured too high then you can observe that after high load head speed will not drop immediately but can be there even for few seconds.
When Min. parameter is changed it is also necessary to update this one.

Throttle Reverse
Especially for Nitro and Gasser motors you can set correct compensation direction for the servo here.

Sensing Divider
Electric motor: Motor poles / 2. For a 10 pole motor set divider to number 5. Mostly configured to 3 – 5.
Nitro/Gasser motor: Number of all active magnets. Mostly it is 1 – 2.

Gear Ratio
Gear Ratio of the helicopter between the main wheel and pinion of the motor. For example: 120T main gear / 12T pinion = 10.

Max. Head Speed
Configure max. head speed that should be achieved with 100% throttle curve. For example: If you know that you won't exceed 2500 RPM then you can set the value to 2500. With 80% throttle curve your head speed will be 2000 RPM (2500 * 0.80 = 2000).

Governor Response
This parameter is the most important one to achieve fast and proper response of the governor. It determine how fast the governor should react to a short-term load. Thus optimal settings are required. If configure too low or too high, rudder will not hold properly and can oscillate.
Governor can greatly affect rudder performance so you can achieve better holding behavior. Too high value will result in overspeeding during e.g. pitch pump.

Holding Performance
Determine how well the head speed is maintained during a long-term load.
If value is too low then during e.g. tic-toc maneuver head speed can drop gradually. In case it is too high then after the tic-toc head speed can be higher than necessary and can even return to requested RPM with noticeable delay.
It is better to start governor tuning process with low value.

5.7.5 Fine-Tuning Procedure

Firstly you have to finish basic setup including *Max. Head Speed*.
Throttle curve in the transmitter must be FLAT. We recommend to set the throttle curve for example to flat 70%, 80% or 90%.

After disarming Throttle Hold you should immediately see *Requested RPM* in the software – this is desired head speed that should be maintained.
Current RPM is head speed that is currently on the rotor head.
If *Current RPM* is not calculated properly, then there is a problem with Gear Settings. In case that you can see zero or random *Current RPM* value then there is a problem with RPM Sensor and must be fixed.

Method A
To tune governor we recommend to start with values:

- Governor Response: 3
- Holding Performance: 3

If RPM is not holding well, you can increase both values equally. Remember that too high values can result in bad rudder performance so steps should be done carefully.
For electric helicopters both values are mostly between 3 to 5.

Method B
In case that governor fine-tuning is not going as expected we recommend to start with:

- Governor Response: 3
- Holding Performance: 1

Then you can increase Governor Response until head speed is maintained well during for example pitch pump maneuver. When you will notice overspeeding effect during a collective changes when hovering then the value is already too high.
When Governor Response is tuned you can start to increase Holding Performance if needed.

NOTE

- Even when governor is enabled you can program the ESC so that the unit is initialized with high throttle position. In this case governor will be inactive from this point until the unit is restarted.

- For throttle curve under approx. 15% governor is inactive – throttle is controlled directly.

- You should see "Governor was Engaged" event in the log after spoolup with enabled governor.

- In case that the *Current RPM* value is 4500 RPM measurement is out of range. It may be needed to change count of the active magnets.

- Very low RPM value is not displayed.

- List of the supported RPM sensors and their wiring will be updated on the forum.

5.8. SOFTWARE KEYBOARD CONTROL

For fast and easy configuration we have implemented keyboard controls in the software.

Shortcut	Function
F1 to F10	Switch between tabs.
ESC	Exit current window.
CTRL + S	Save settings to the unit.
CTRL + P	Save profile to your computer.
CTRL + L	Load profile from your computer to the unit.
Numpad 0, 1, 2	Switch between banks.
Tab	Switch between parameters.
Space	Select parameter / option
Arrows	Increase / Decrease value.
Page Up / Page Down	Increase / Decrease value by tens.
Home	Set the lowest value.
End	Set the highest value.

6. FIRST FLIGHT

If you are sure that the unit is correctly configured, you are ready for your first flight.

6.1. PRE-FLIGHT CONTROL

1. Turn on the transmitter and connect the battery to the model.
2. Wait for the initialization, the swashplate jumps.
3. Tilt the model, ensure the swashplate is compensating in the correct direction on all axes.
4. Move the tail boom in any direction, the tail slider/rudder blades should compensate in the opposite direction.
5. Check that input from the transmitter sticks moves the swashplate and tail in the correct directions.
6. Place the model on a flat surface, use the transmitter sticks to level the swashplate if it isn't already, the tail slider should be approximately in the center of its travel range.

WARNING
If you encounter a problem or something appears wrong at this point, do not try to take off!

6.2. TAKEOFF

1. Spool up the main rotor to the desired speed - we recommend to start with a slightly lower RPM.
2. Slowly increase the collective pitch from zero.
3. Try to steer the rudder and check whether it has sufficient gain and stop performance is good.
4. If control is not very precise, slowly add cyclic and rudder gain as needed.

7. PROBLEMS AND SOLUTIONS

Problem description	Solution
Swashplate or tail drifts after initialization	Check trims and subtrims. Sticks in neutral position must be 0%, see the *Diagnostics* tab. Increase Stick deadband in *Advanced tab.*
Rudder or cyclic is not precise	Increase cyclic gain and/or increase the gyro gain in the transmitter. Add exponential in the transmitter.
Aggressive cyclic pitch movement or fast forward flight leads to rapid, large tail oscillations	Decrease pirouette consistency in the *Advanced tab* gradually by 10 until this disappears. Check the tail mechanics for binding.
Model oscillates in elevator or aileron axes	Decrease cyclic gain in *Sensor* tab.
Tail oscillates rapidly	Decrease gyro gain in the transmitter.
Model pirouette rotation is too slow/fast	Increase/decrease rotation speed for rudder in *Sensor tab.*
Servos jitter randomly without external influences	Check the cable connection between the receiver and the unit.
During stationary pirouettes model drifts	Check the correct direction of pirouette optimization in *Advanced* tab.
Aggressive elevator stick movement leads to bouncing	Increase elevator filter in *Advanced* tab and/or decrease cyclic feed forward in *Advanced* tab.
Cyclic feel is delayed or disconnected	Increase cyclic feed forward in *Advanced* tab.
Rudder stop is not equal for both sides	Check rudder servo center position, rudder mechanics. You can also try to lower rudder limit for the side where bounce-back occur.

8. THANKS

To all who in any way participated and are participating in the development of Spirit, many thanks!

Special thanks to:

Adam Kruchina
Daniel Beneš
Daniel Matloch
David Henderson
Dušan Habada
Elke Lalanza
James Pizzey
Jens Lalanza
Martin Přinda
Martin Štvrtňa
Milan Křivda
Milan Pěchovič
Petr Čada
Petr Koťátko
Rafael Villarta Castillo
René Štefánik

Declaration about conformity

It is hereby confirmed that Spirit unit is being produced according to EMC directive 2004/108/EC, electromagnetic compatibility.

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